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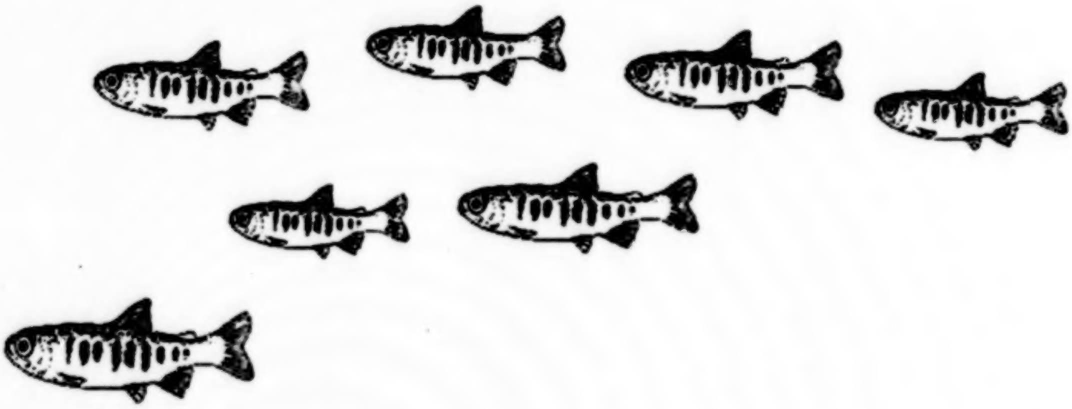
ABUNDANCE AND SURVIVAL

OF

JUVENILE CHINOOK SALMON

IN THE

SACRAMENTO-SAN JOAQUIN ESTUARY



1996 ANNUAL PROGRESS REPORT
SACRAMENTO-SAN JOAQUIN ESTUARY
FISHERY RESOURCE OFFICE
U.S. FISH AND WILDLIFE SERVICE
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May 2000

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Acknowledgments

This sampling was conducted for and funded by the Interagency Ecological Program (IEP) for the Sacramento-San Joaquin Estuary. Members of the IEP include three state and six federal agencies: California Department of Water Resources, California Department of Fish and Game, State Water Resources Control Board, U.S. Bureau of Reclamation, U.S. Geological Survey, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency.

Introduction

Work in 1996 by the Sacramento-San Joaquin Estuary Fishery Resource Office (SSJEFRO) was conducted to update and refine our knowledge of the factors influencing juvenile salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. Field sampling and special studies were conducted between August 1, 1995, and July 31, 1996 (referred to as the 1996 field season), with various sampling gears as juveniles rear and migrate through the lower Sacramento and San Joaquin Rivers and Delta.

Objectives of the 1996 Interagency Salmon Study were to:

- Monitor the relative abundance, distribution, and timing of juvenile chinook salmon rearing and migrating through the lower Sacramento River and Delta.
- Determine relative survival (using fall and late-fall hatchery smolts) of juvenile salmon released in the upper river and Delta, and identify potential factors influencing survival.
- Identify management measures that could reduce the impacts of water project operations and other controllable factors on salmon migrating through and rearing in the Delta.

Midwater trawling, Kodiak trawling, and beach seining were employed at varying times and locations in the Delta and lower Sacramento and San Joaquin Rivers. Different sized juveniles of the various races of chinook salmon presumably have distinct spatial and temporal distributions making them vulnerable to different gear types in the Delta. Although the largest juveniles (greater than 150 mm) probably are not effectively sampled using the gears employed by this office, the salvage facilities in the South Delta catch larger sized juveniles helping us to further understand the abundance, distribution, and survival of juvenile salmon in the Delta.

Elements of the study in 1996 were:

Lower Sacramento River

- A weekly beach seining survey between Ord Bend (River Mile (RM) 184) and Elkhorn (RM 71) on the lower Sacramento River from August 1, 1995, to July 31, 1996, to estimate the relative abundance and distribution of all races of salmonid fry in the lower Sacramento River (Figures 1 and 2).

Delta

- Weekly beach seining from Discovery Park (RM 60) on the Sacramento River to Antioch and in various locations in the central and Southern Delta and the lower San Joaquin River. The goal was to also estimate the relative abundance and distribution of all races of salmonid fry in the Delta between August 1, 1995, and July 31, 1996 (Figures 2 and 3).
- A midwater trawl survey at Sacramento from three to five days per week between August 2, 1995, and October 23, 1995, and between April 1, 1995, and July 31, 1996, to estimate the relative abundance of juvenile salmon entering the Delta (Figure 4). Knowing when the various races of chinook juveniles enter the Delta is helpful in managing water project protective criteria, such as the operation of the Delta Cross Channel Gates.

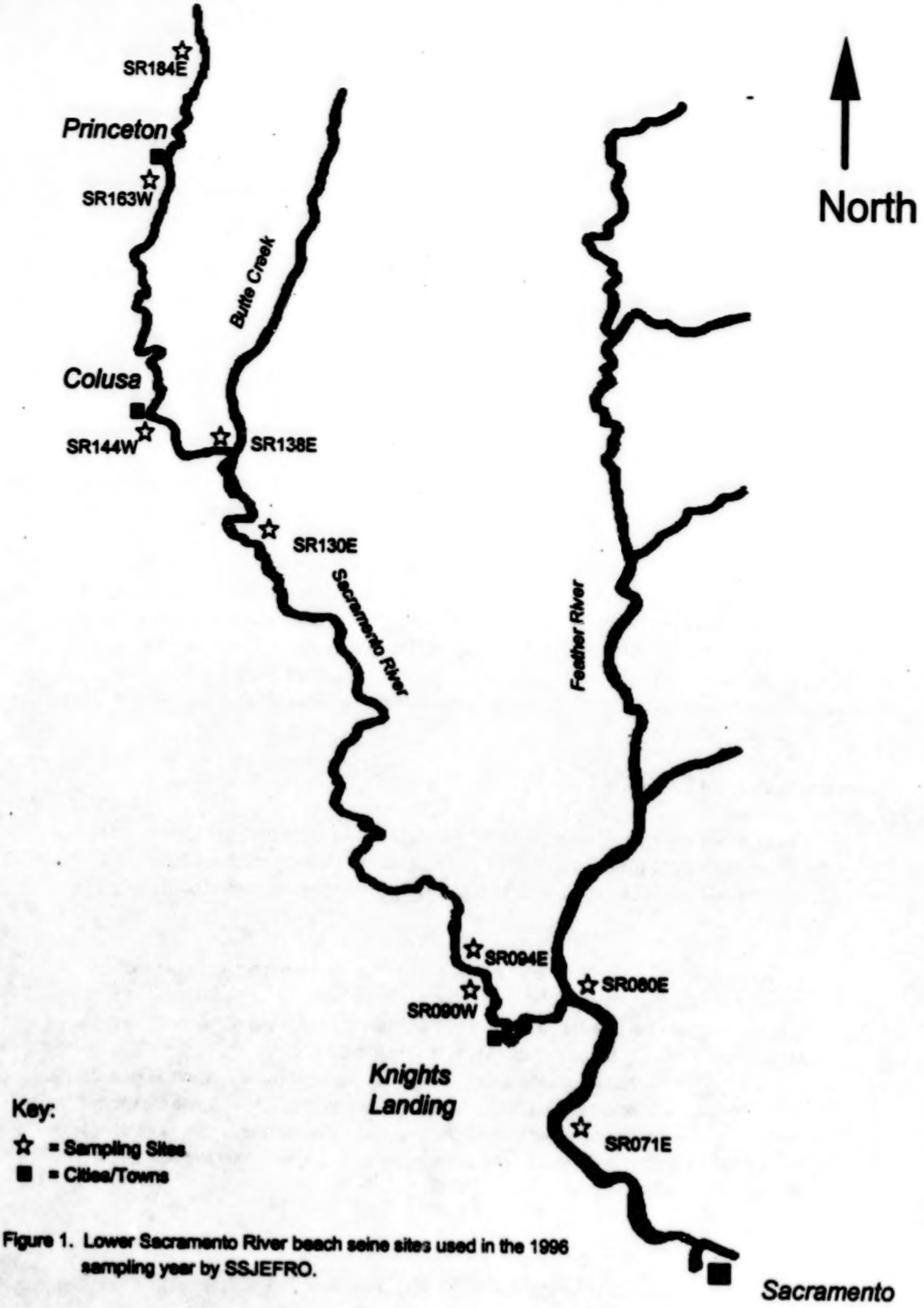


Figure 1. Lower Sacramento River beach seine sites used in the 1996 sampling year by SSJEFRO.

Lower Sacramento River Seine

SR184E	Ord Bend
SR163W	Princeton
SR144W	Colusa State Park
SR138E	Ward's Landing
SR130E	South Meridian
SR094E	Reels Beach
SR090W	Knights Landing
SR080E	Verona
SR071E	Elkhorn

Central Delta Seine

LP003E	Terminous
XC001N	Delta Cross Channel
GS010E	Georgiana Slough
SF014E	Wimpy's
MK004W	B&W Marina
DS002S	King's Island
SJ005N	Eddo's
TM001N	Brannon Island
SJ001S	Antioch Dunes (Antioch Dunes National Wildlife Refuge)

San Joaquin Seine

SJ056E	Mossdale
SJ058W	Weatherby
SJ063W	Big Beach
SJ068W	Durham
SJ074W	Sturgeon Bend
SJ077E	Route 132
SJ083W	North of Tuolumne River

North Delta Seine

SR060E	Discovery Park
SR049E	Garcia Bend
SR043E	Clarksburg
SS011N	Steamboat Sl.
SR024E	Koket
SR017E	Isleton
SR014W	Rio Vista
AM001S	American River
SR012E	Stump Beach
MS001N	Sherman Island

South Delta Seine

TC002E	Turner Cut
SJ032S	Lost Isle
SJ026N	Venice Island
WD002W	Veale Tract
OR019E	Old River
MR010W	Woodward Island
SJ041N	Dad's Point
VC002N	Victoria Canal
SJ051E	Dos Reis

Trawl

SB018X	Chipps Island
SR055M	Sherwood Harbor

Rotary Screw Trap

XC001N	Delta Cross Ch.

Sacramento Seine

Verona (SR080E), Elkhorn (SR071E), Sand Cove (SR062E), Discovery Park (SR060E), Miller Park (SR057E), Sherwood Harbor (SR055E), Garcia Bend (SR049E), Clarksburg (SR043E)

Figure 2. Station codes and names for all gears used by SSJEFRO in 1996. The beach seine sites in the Lower Sacramento River sampling area are upstream of the city of Sacramento on the Sacramento River (RM 60). The North Delta seine sites are south of Sacramento on the Sacramento River. The Central Delta seine sites are between the Sacramento and San Joaquin Rivers and the South Delta seine sites are located in the Interior Delta south of the San Joaquin River. The San Joaquin River seine sites are upstream of Dos Reis Park (RM 51) on the San Joaquin River. The Sacramento seine ranges from Verona (RM 80) to Clarksburg (RM 43) on the Sacramento River and consists of three sites exclusively for the Sacramento area seine: Sand Cove, Miller Park, and Sherwood Harbor.

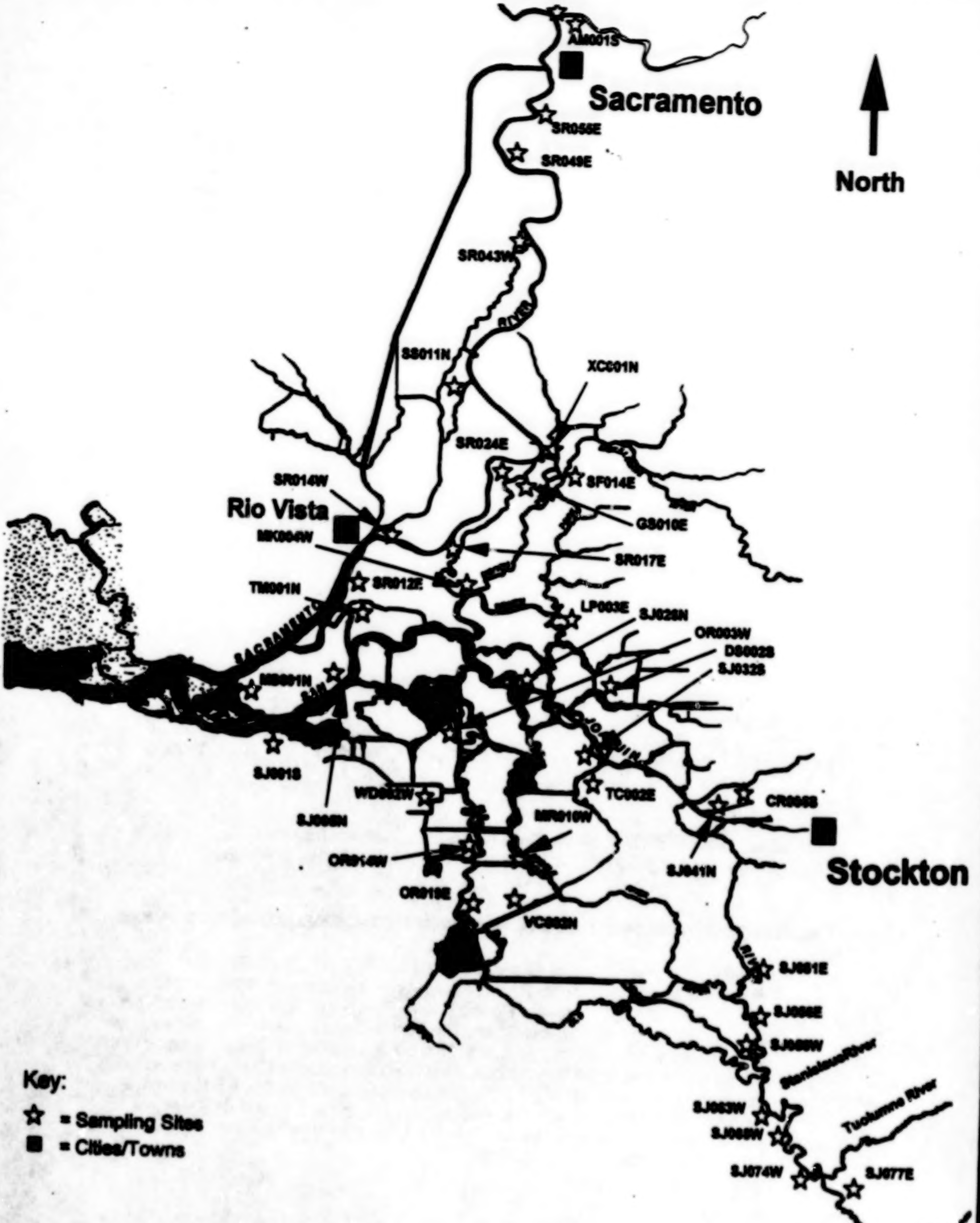


Figure 3. Delta beach seine sites used by SSJEFRO in the 1996 field season.

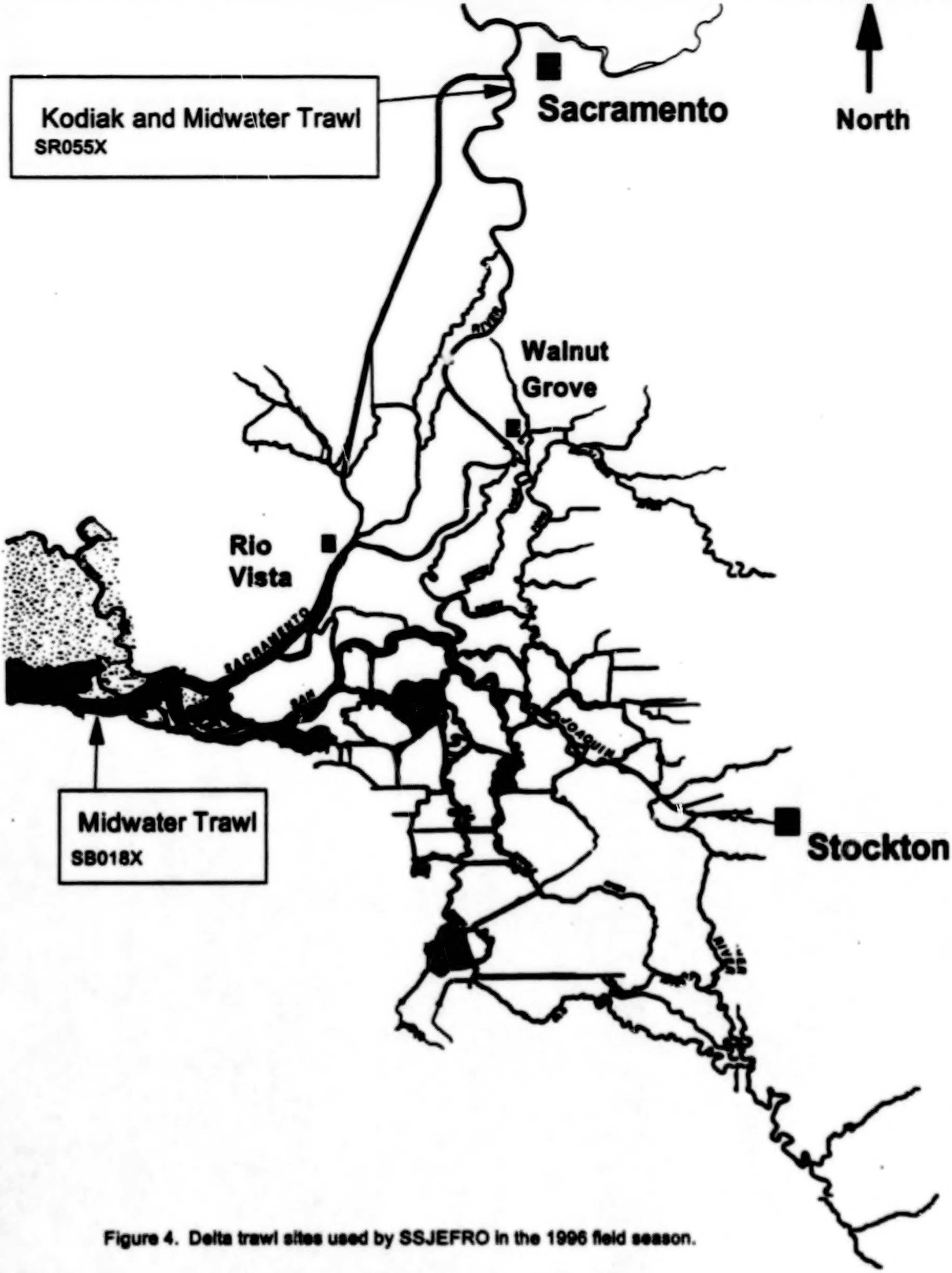


Figure 4. Delta trawl sites used by SSJEFRO in the 1996 field season.

- A Kodiak trawl survey at Sacramento between October 25, 1995, and April 4, 1996, between three and seven days per week (Figure 4). The Kodiak trawl, which is pulled through the water with two boats has a larger net opening than the midwater trawl used at that location in the past. It was used to increase the efficiency of capturing the larger and less abundant chinook that are typically present during the fall/winter period.
- A midwater trawl survey was conducted at Chipps Island, from three to seven days per week between August 2, 1995, and July 29, 1996 (Figure 4). The trawl at Chipps Island is used to index the number of unmarked fish emigrating from the Delta and to recover marked smolts released in mark and recapture experiments.
- Coded wire tagged (CWT) mark and recapture studies were conducted to determine Delta survival of fall run and late-fall run juveniles under varied environmental conditions.

Specific questions addressed by tag studies in 1996 were:

Sacramento/Delta:

What is the survival of salmon smolts migrating through the Delta (released near Sacramento), under various environmental conditions?

San Joaquin Delta

What is the survival of salmon smolts migrating down the San Joaquin River without a barrier at the head of Upper Old River?

CWT recovery data generated by the ocean fishery is available to confirm past conclusions based on trawl recovery information.

1996 Water Year Conditions

The 1996 water year (October 1995 - September 1996) was classified as wet. Outflow at Verona in October and November was relatively dry but a series of large storms hit the Sacramento River Basin in December, January, and February, boosting the yearly rainfall and runoff totals above average (United States Geological Survey, 1997). Figure 5 shows the mean flow at Verona between 1946 and 1995, and the mean flow at Verona during 1996. March, April, and May outflow was below normal, and a storm in late-May increased the average outflow to near normal in June.

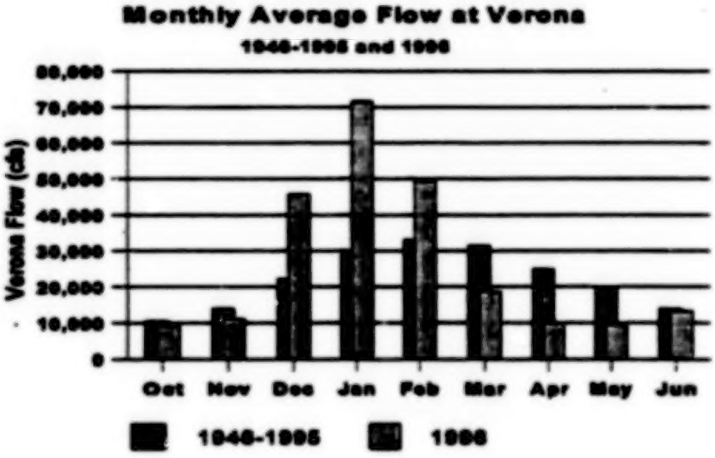


Figure 5. Mean flow on the Sacramento River at Verona between 1946 and 1995, and during 1996.

Race Delineation by Size

The SSJEFRO is one of several salmon monitoring groups within the Central Valley that use size and date of capture to determine juvenile chinook salmon race in the lower Sacramento River and Delta. The daily size criterion was developed by Frank Fisher, of California Department of Fish and Game in 1992, and later modified by Sheila Greene of the California Department of Water Resources. At this time it is the only tool used to determine race of juvenile salmon in the field. However, several problems exist regarding its validity that have been discussed in past reports (United States Fish and Wildlife Service, 1994). For the reasons identified in previous reports, the race designations used in this report should only be used as a rough approximation and not interpreted as definitive. Genetic differentiation of races is promising and may help determine true race of Central Valley salmon juveniles in the future.

Although all four races are designated in the field using the size criteria, for this report the fall and spring run categories have been combined into a group identified as fall/spring run.

Life Stage Deliniation

Because designations of the various life stages of juvenile chinook depend on the physiological state of the fish, the use of fork length does not clearly define these stages but can be a rough estimate of this classification. For this report we have defined fry as being below 70 mm fork length. Juveniles larger than fry are likely starting to undergo behavioral and physiological changes to prepare them for the transition to salt water. We have defined them as smolts. Yearlings have been defined as juveniles residing in freshwater approximately one year.

Escapement

To help understand the abundance changes of the juvenile salmon populations in the Delta, graphs of the annual number of adults of each race passing Red Bluff Diversion Dam (RBDD) in the upper Sacramento River are shown in Figure 6. There have not been any late-fall escapement estimates at RBDD since 1992 due to the opening of the gates as a result of the winter run biological opinion. For escapement estimates to be properly obtained, the RBDD gates must be in the closed position. This does not occur during late-fall upstream migration. Fall run populations are also present in the American and Feather Rivers and San Joaquin River tributaries (Figure 7) and would also influence the number of fall run juveniles using the Delta. Escapement in 1995 was generally high in the American and Feather Rivers. Fall/spring run escapement was average in the upper Sacramento River, and low in the San Joaquin basin during 1995.

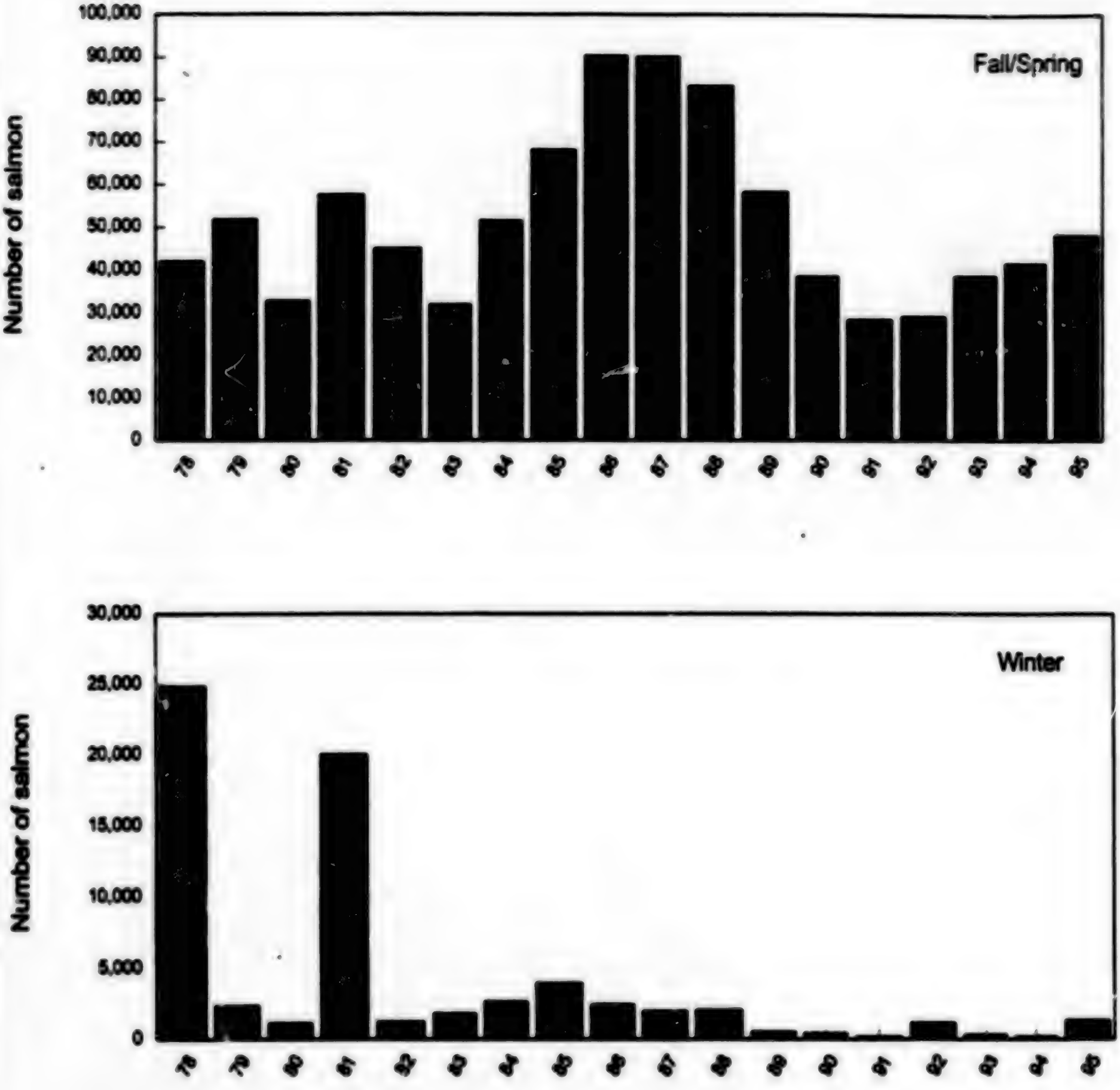


Figure 6. Red Bluff Diversion Dam yearly escapement estimates of naturally spawning spring, fall, and winter run. Years 1986 to 1995 are preliminary. Source: Department of Fish and Game, Inland Fisheries Division, Red Bluff.

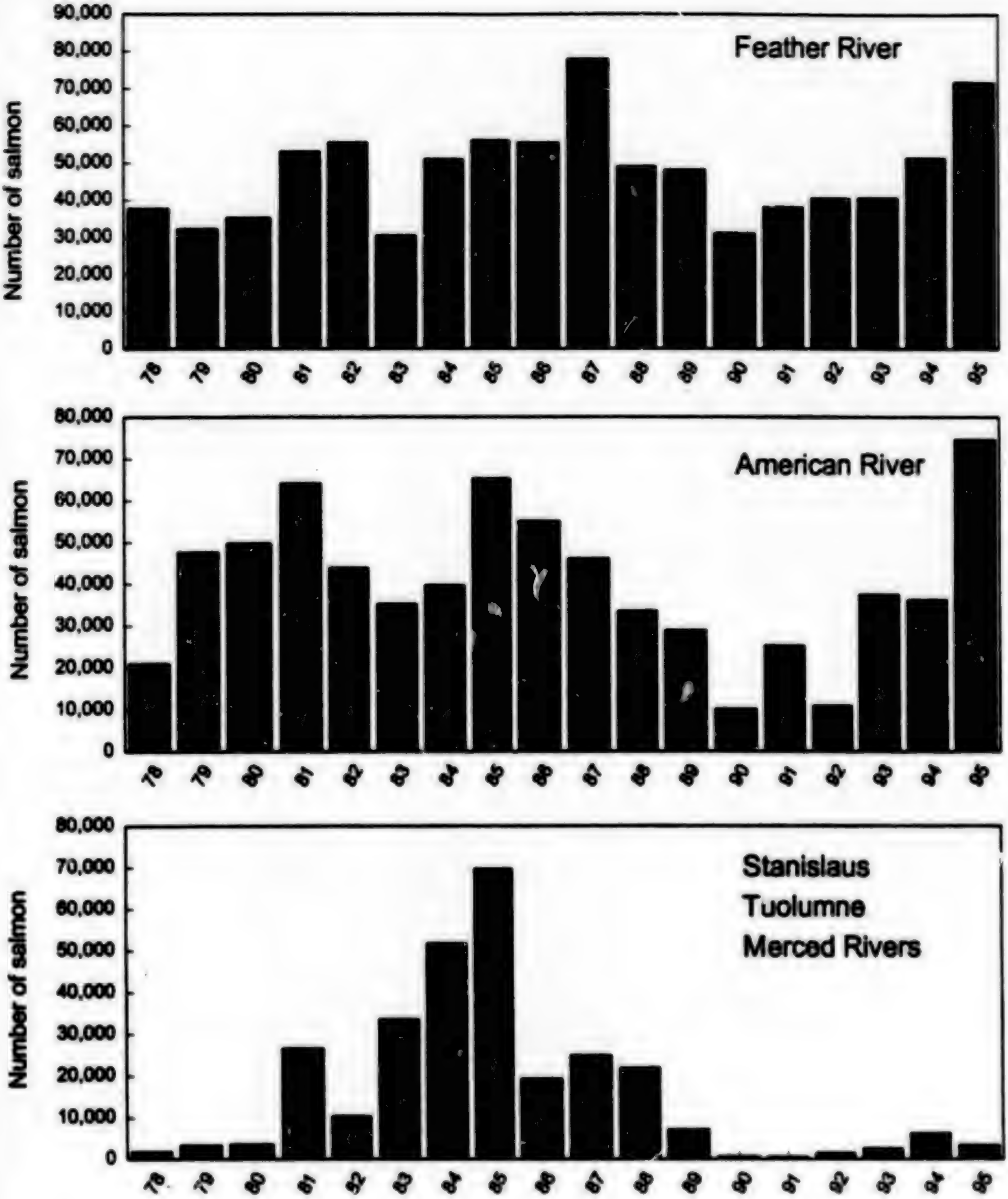
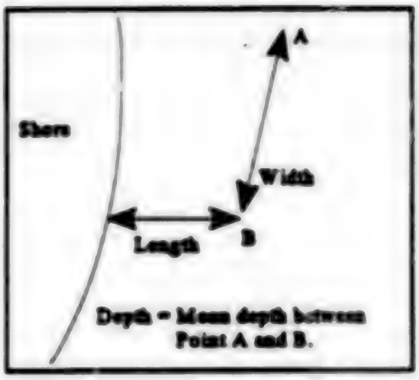


Figure 7. Spawner population estimates of fall run chinook salmon between 1978 and 1995 on the Feather and American Rivers, and the Stanislaus, Tuolumne, and Merced Rivers combinded.

Methods

Beach Seine

All seining was done with a 15 meter x 1.2 meter (50' x 4') 3 mm (1/8") delta square mesh beach seine with a 7.5 meter (4') long bag. One seine haul was attempted at each site. Seine sites consisted of cement boat ramps, sandy beaches, gravel bars, and muddy inlets. The majority of sites on the Sacramento River and Delta have been sampled since the mid-1970's to document the relative abundance of juvenile chinook salmon between and within years. Every attempt was made to seine the original historical sites to retain validity of year to year catch per unit of effort comparisons. Occasionally, changes in flow or excessive traffic prevented seining a site.



Before valid comparisons in abundance and timing within and between years were made, catches were corrected for effort by standardizing to catch per cubic meter (CPM^3). Catch per cubic meter for each beach seine haul was calculated using the following equation in meters (see diagram on left):

$$\text{Seine CPM}^3 = \quad \text{Catch/ (.5) depth X width X length}$$

Midwater trawl

The midwater trawl net used at Sacramento was a variable mesh net with a fully extended mouth size of 1.8 meter x 4.6 meters (6' x 15') tapering to a cod end of 3 mm mesh (1/8"). This net has been used at or near this location during the spring since 1988. Figure 8 is a schematic drawing of the midwater trawl net. One pair of heavy bottom doors spread the net at the lead line and one pair of top doors with floats spread the top of the net at water level. Though it is called a midwater trawl net due to its design, it is fished on the surface of the water. Actual fishing dimensions of the net vary due to currents and weather conditions and have been described in past reports (United States Fish and Wildlife Service, 1993). The larger midwater trawl net used at Chipps Island (Figure 9) is similar in construction to the midwater trawl net used at Sacramento and has a mouth dimension of 3 meters x 9 meters (10'x30').

Ten twenty minute trawls were done per sample day at both locations. All trawling at Sacramento was done in the middle of the channel facing upstream against the current within 1.5 kilometers of the sample site. Trawling at Chipps Island also was done within 1.5 kilometers from the sample site in both directions regardless of tide, and in three channel locations: North, South, and middle. Occasionally, inclement weather, mechanical problems, or excessive fish catches required reducing tow times or the number of tows.

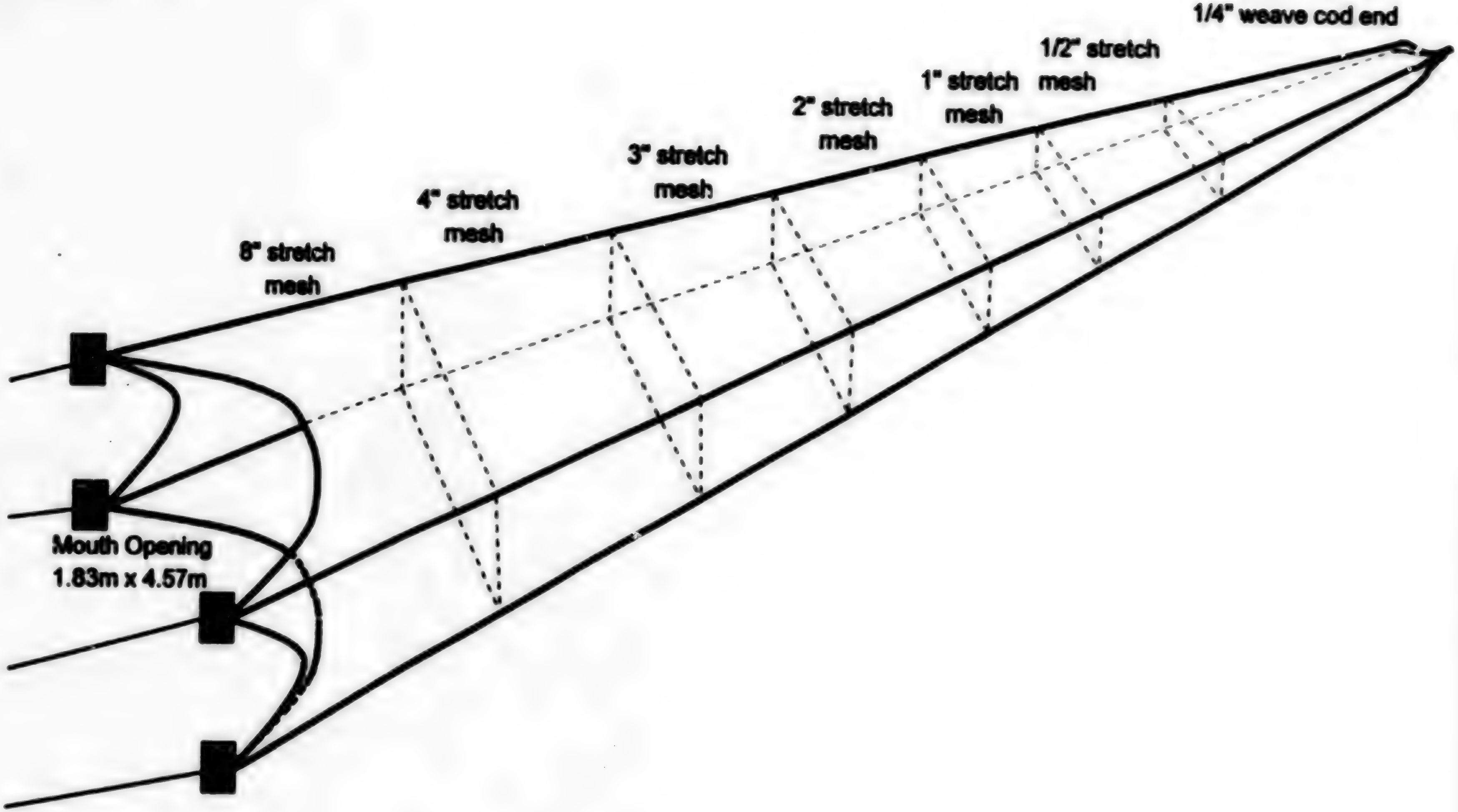


Figure 8. Schematic drawing of the midwater trawl net used at Sacramento during the 1998 field season.

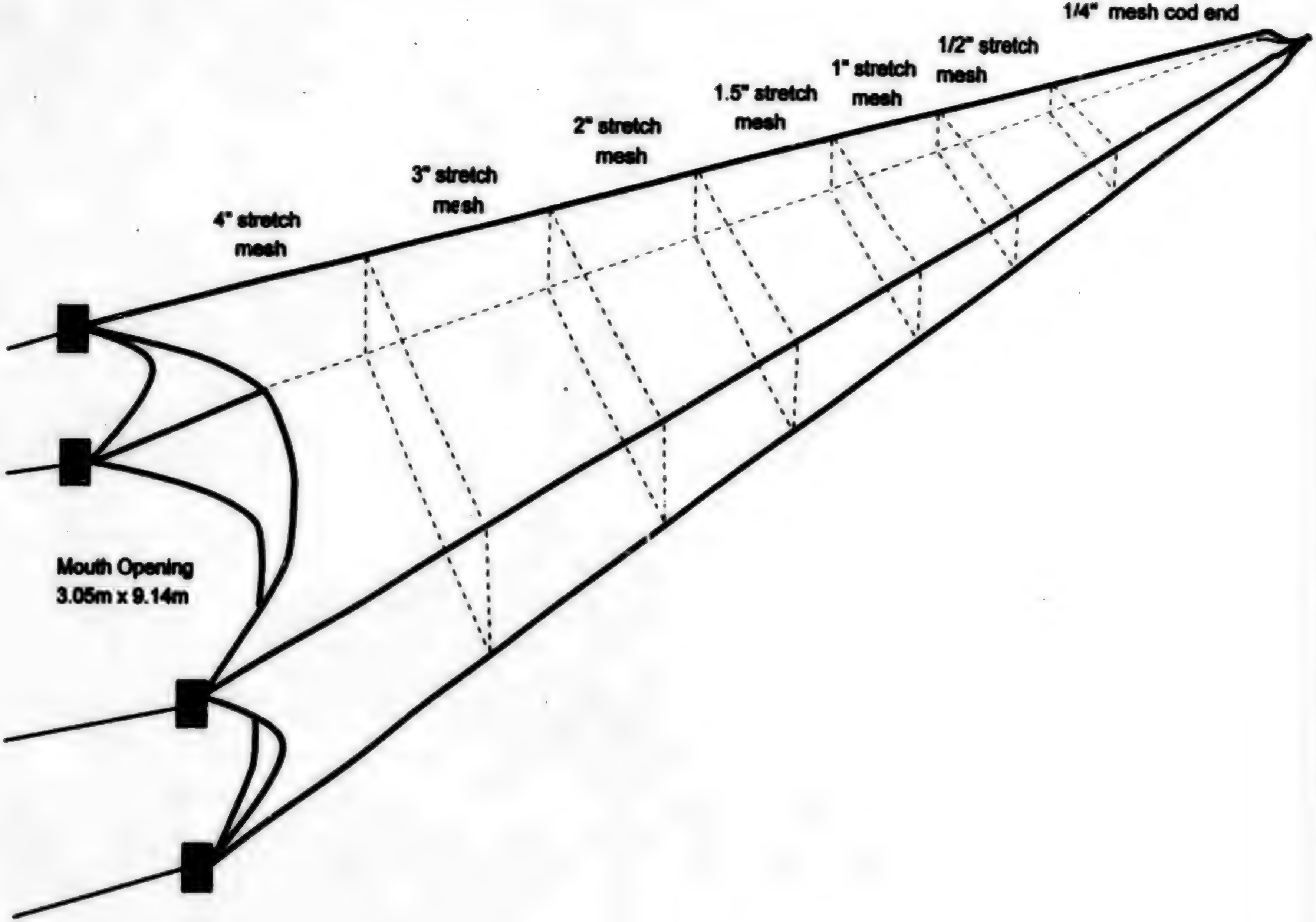


Figure 9. Schematic drawing of the midwater trawl net used at Chipps Island during the 1996 field season.

Catch by cubic meter per tow in the midwater trawl was calculated with the following formula:

$$\frac{\text{catch per tow}}{\text{net mouth area } (m^2) \text{ X distance net passes through water column(m)}}$$

The net mouth area in the small and large midwater trawl nets used for calculations were actual estimated net mouth fishing areas. Previous studies showed that the midwater trawl nets don't open completely while under tow (United States Fish and Wildlife Service, 1993) and that mouth dimensions vary within and between tows. Estimated net mouth areas used in this report were the mean mouth openings calculated from these studies. The estimated net mouth areas while fishing were 5.1 square meters for the small midwater trawl used at Sacramento and 18.6 square meters for the large midwater trawl used at Chipps Island. The distance the net passes through the water column defined in meters was measured during each tow with a General Oceanics mechanical flow meter (model 2030). Total revolutions per tow were counted by the flow meter and converted to linear distance using standard equations as described in the General Oceanics manual. This is a measurement of the distance of water sampled and is not related to distance traveled relative to land which can be effected by tides and currents.

Kodiak trawl

The Kodiak trawl net also was variable mesh with a fully expanded mouth opening of 6 x 25 feet (1.83 x 7.62 meters) and is shown in Figure 10. The estimated fishing net mouth area, extrapolated from midwater trawl studies (United States Fish and Wildlife Service, 1993), was 12.5 square meters for the Kodiak trawl. A float line and lead line enabled the net to fish the top 1.8 meters of the water column. At the front of each wing was a 1.8 meter bar keeping this depth constant. The Kodiak trawl was fished with an aluminum live box as a cod end to avoid excessive fish mortality. Two boats pulled the Kodiak net through the water, one dragging each wing. At the end of each tow, one of the boats retrieved the live box from the net and removed the fish. The method used to calculate catch per cubic meter per tow is the same as the midwater trawl.

Daily, weekly, and monthly CPUE calculations

Data was summarized using monthly catch per cubic meter (CPM^3) values. The average monthly CPM^3, unless otherwise specified, was calculated based on the daily and weekly averages as shown in the following formulas.

$$\text{Average Daily } CPM^3 = \frac{\sum_{i=1} (\text{site/tow } CPM^3)}{\text{\# sites/tows sampled in each day}}$$

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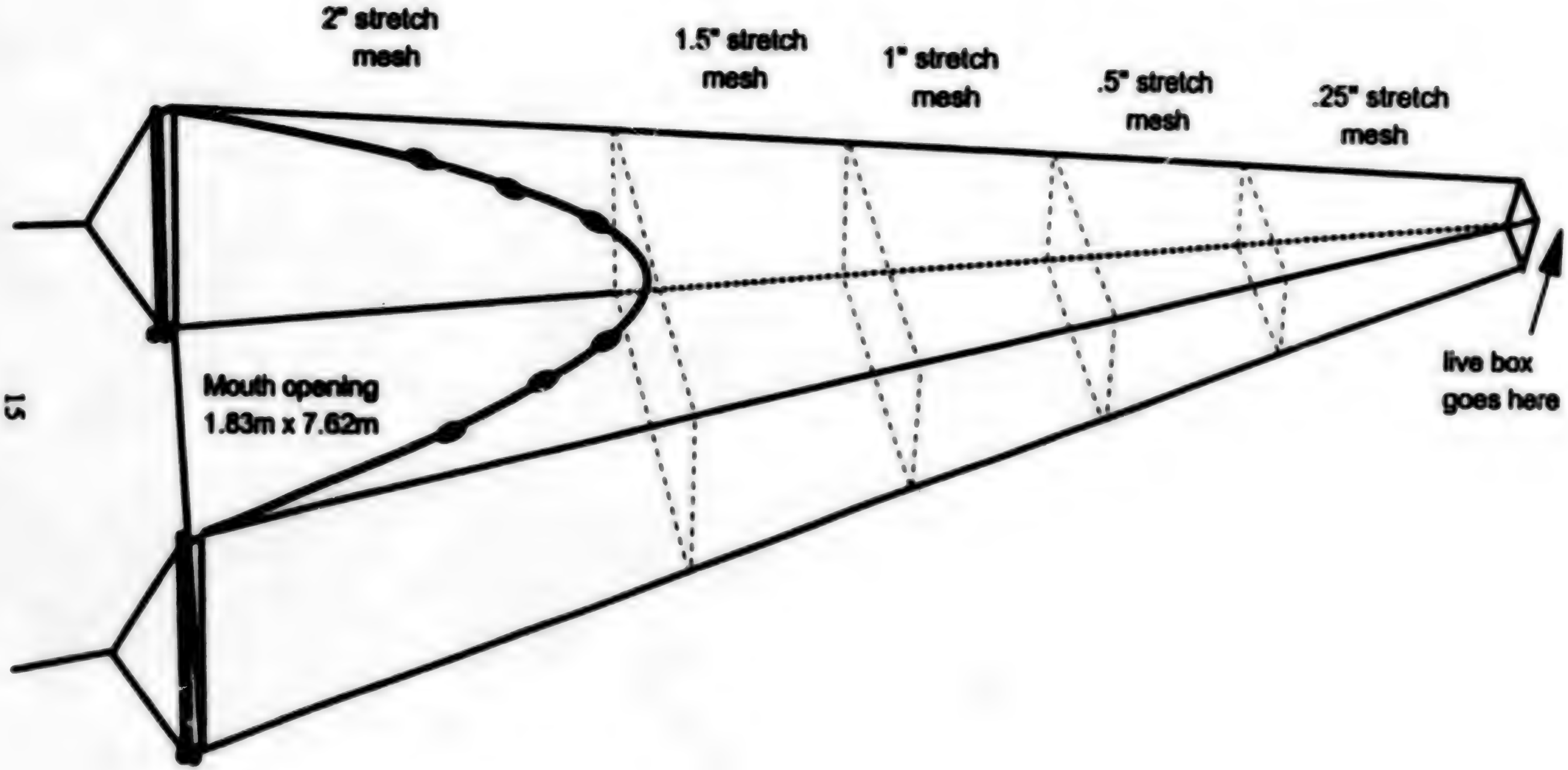


Figure 10. Schematic drawing of kodiak trawl net used at Sacramento during the 1996 field season.

$$\text{Average Weekly CPM}^3 = \frac{\sum_{i=1} (\text{daily CPM}^3)}{\text{\# days sampled in each week}}$$

$$\text{Average Monthly CPM}^3 = \frac{\sum_{i=1} (\text{weekly CPM}^3)}{\text{\# weeks sampled in each month}}$$

The monthly CPM^3 is the sum of weekly CPM^3 divided by the number of weeks sampled per month. Weeks were designated as Monday-Sunday and weeks which overlap months were split and included in their respective months. Each average weekly CPM^3 was calculated by averaging all daily means within the week. The daily CPM^3 was the average of all tows for trawl and all sites for seine for each day.

Lower Sacramento River Beach Seine

To estimate the relative abundance of juvenile chinook salmon in the lower Sacramento River, beach seining was conducted at nine sites once per week from August 1, 1995, through July 31, 1996. The area sampled was from Ord Bend (rm 184) downstream to Elkhorn (rm 71). The substrates sampled were cobblestone, sand, and paved boat ramps. Flow information at Colusa was obtained from a Department of Water Resources recording station (rm 144).

The most abundant race captured in the lower Sacramento River during the 1996 field season was fall/spring (Table 1 and 2, Figure 11). Size ranged between 29 and 98 mm fork length with an average of 42 mm. Catches occurred between August 22, 1995, and July 2, 1996. Many fry were captured during the high flow period in December, January, and February. Larger, smolt sized fall/spring run were captured in the spring. These fish did not leave the lower Sacramento River during the high flows of winter but rather migrated when temperatures were higher and flows lower during the spring. Fall/spring are typically smaller than late-fall or winter run when leaving the lower river and are more vulnerable to capture in the seine than the other races because of their small size and thus preference for shoreline habitat. The high susceptibility of fall/spring to capture in the seine and their relatively high abundance compared to other races in the Central Valley makr them very prominent in beach seine catches.

Catch per unit of effort of fall/spring run during the 1994 field season, a critical water year, was considerably lower than in 1995 and 1996 which were both wet years (Figure 12). Highest density was in March during 1994 and in January and February during 1995 and 1996, respectively.

A total of 183 winter run were captured in the lower Sacramento River beach seine during the 1996 field sampling year between December 7, 1995, and April 22, 1996 (Table 1). Catches were greatest in December and January, with catch per unit effort considerably higher during these months than in February, March, and April. These results are similar with trends seen in 1995 (Figure 12). The 1994 field season observed the highest catch per unit effort in February rather than December or January as was the case in 1995 and 1996.

Catches of late-fall juveniles in the lower Sacramento River beach seine during the 1996 field season included juveniles from 1995 (yearlings) and 1996 (fry). Late-fall spawning occurs between January and late-April. Juveniles can enter the Delta as fry in the spring or as yearlings in the fall/winter. It is necessary to observe abundance in both the spring and fall for each brood year to assess the movement through the Delta of each year class of late-fall juveniles.

A total of 20 late-fall yearling sized chinook were captured between August 22, 1995, and January 29, 1996. Size ranged between 73 and 178 mm fork length. As shown in Tables 1 and 2, peak captures were in December. A small population of late-fall juveniles from the 1995 brood year were also captured in the spring of the 1995 field season (Figure 13).

One 1996 brood year late-fall was captured in June along the lower Sacramento River measuring 53 mm. Temperatures in the river during the summer often approach 70 degrees, possibly effecting the survival of late-fall juveniles.

Table 1. Monthly catch of all races of chinook salmon on the lower Sacramento River beach seine survey during the 1996 field season.

Month	Late-fall	Winter	Fall/spring	Totals	No. of Hauls
Aug	4	0	2	6	44
Sept	0	0	0	0	35
Oct	0	0	0	0	60
Nov	0	0	0	0	58
Dec	14	119	1028	1162	80
Jan	2	45	2345	2392	62
Feb	0	14	3854	3868	43
Mar	0	4	2043	2047	58
Apr	0	1	282	283	40
May	0	0	46	46	30
Jun	1	0	0	1	34
Jul	0	0	1	1	43
Totals	21	183	9601	9806	587

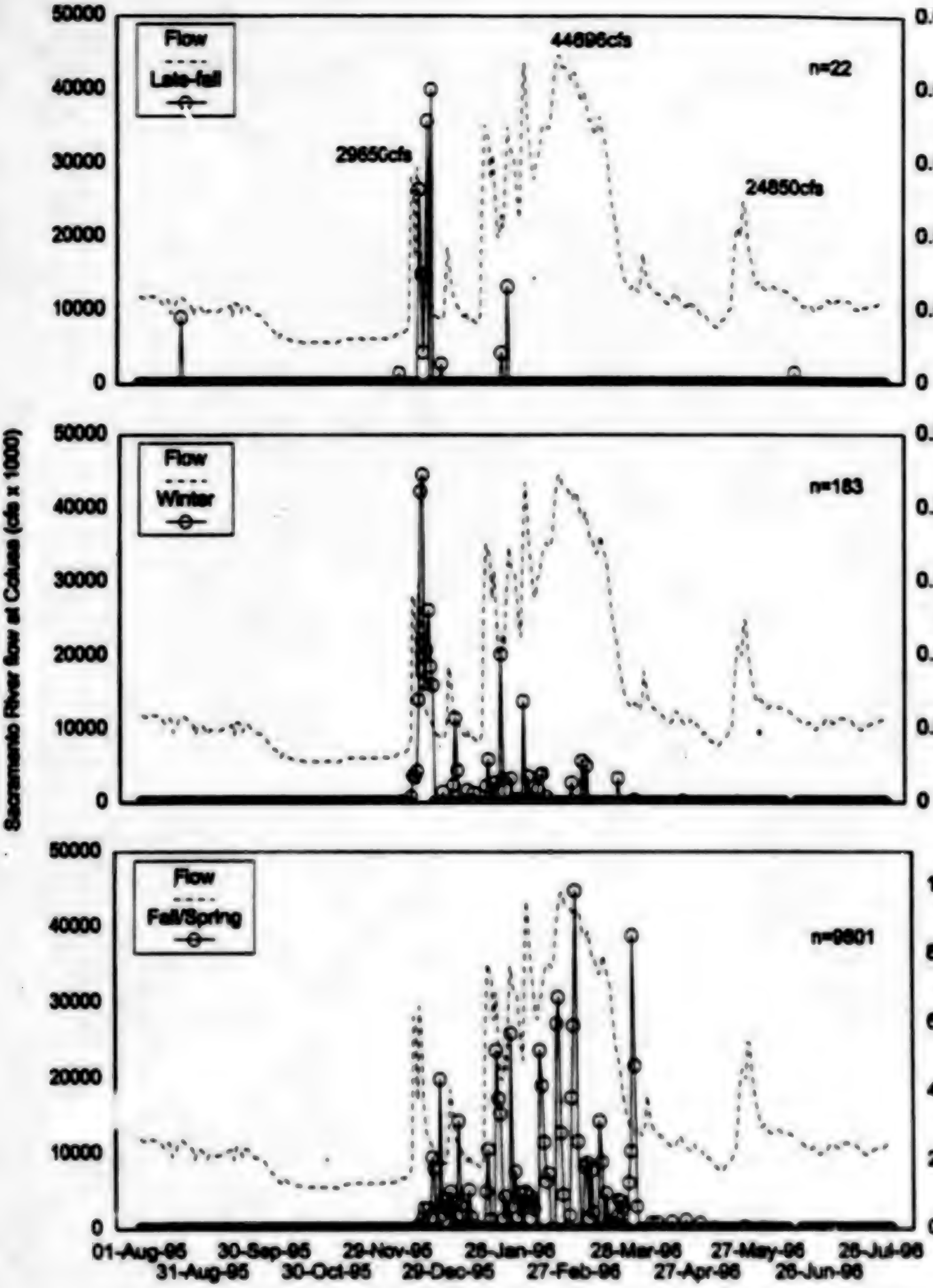


Figure 11. Daily catch per cubic meter in the lower Sacramento River beach seine during the 1996 field season. No flow data is available for June 12-17, 1996.

Table 2. Lower Sacramento River beach seine juvenile salmon catch per cubic meter during the 1996 field season.

Month	Late-fall	Winter	Fall/spring
Aug	0.00091	0	0.00042
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0.00403	0.03046	0.4374
Jan	0.00105	0.01365	1.58885
Feb	0	0.00662	2.74418
Mar	0	0.00305	1.90855
Apr	0	0.00031	0.2225
May	0	0	0.13944
Jun	0.00038	0	0
Jul	0	0	0.00023

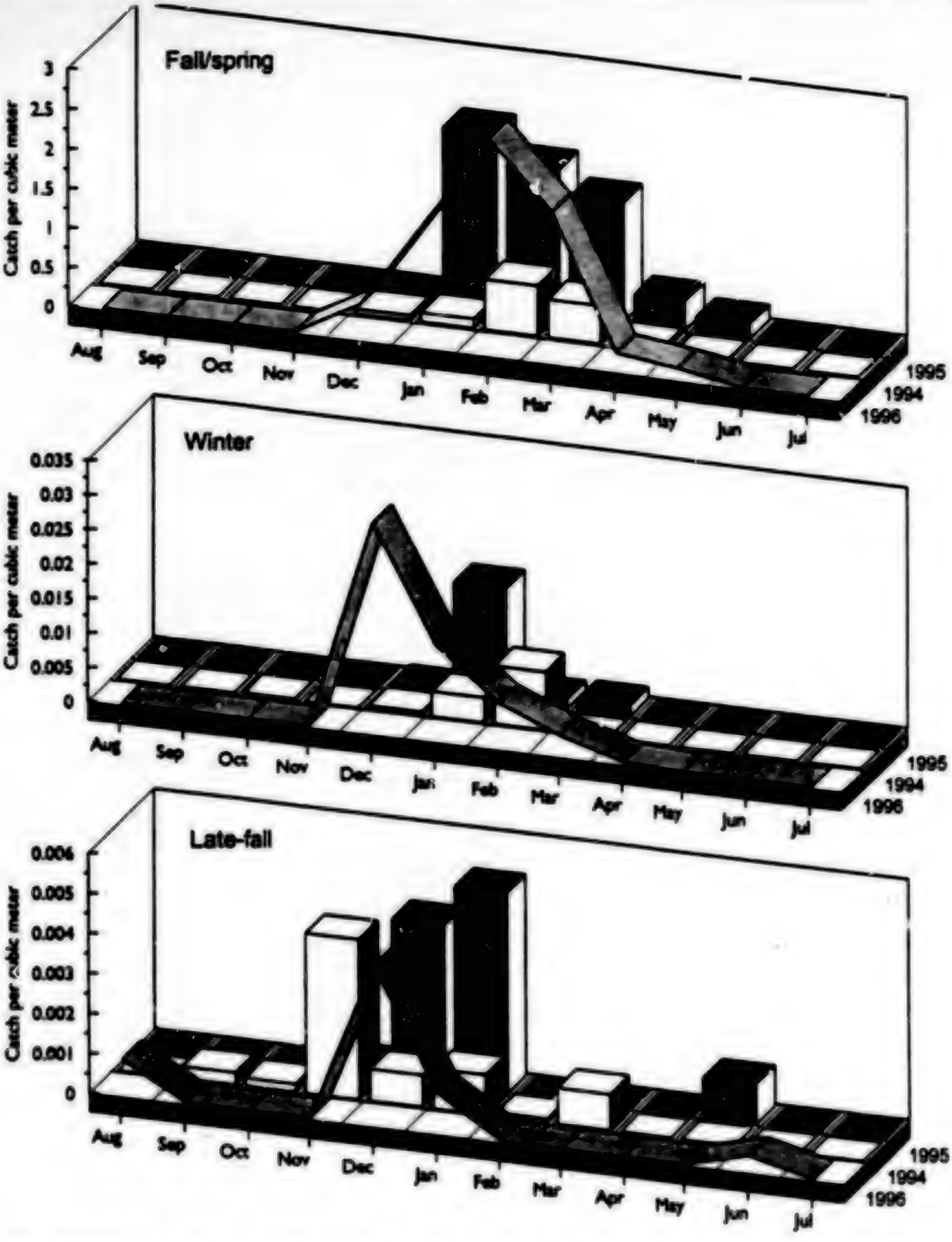


Figure 12. Monthly catch per cubic meter of fall/spring run chinook salmon in the lower Sacramento River beach seine during the 1994, 1995, and 1996 field seasons.

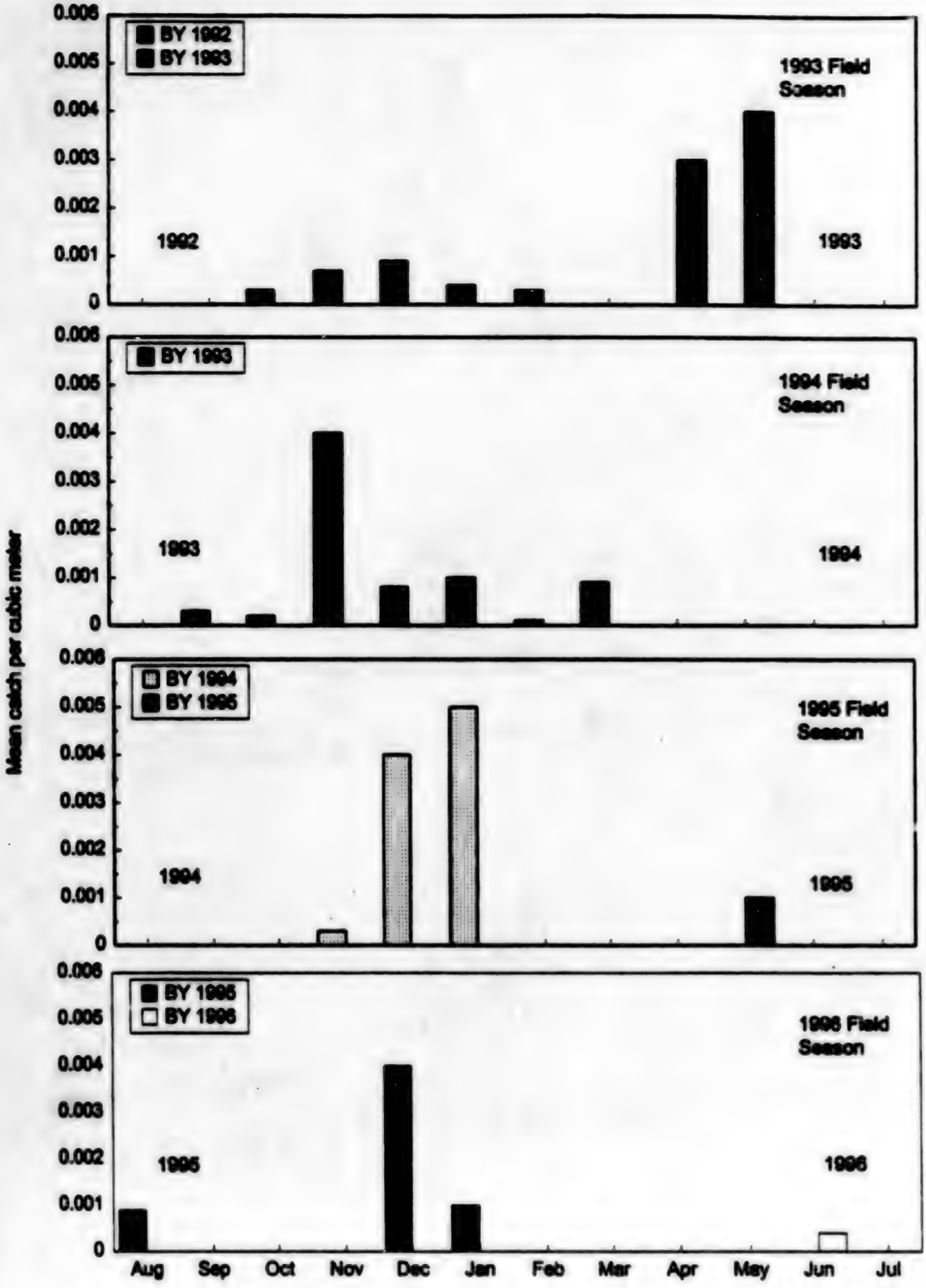


Figure 13. Mean Catch per cubic meter of late-fall chinook in the beach seine in the lower Sacramento River brood years (BY) 1993, 1994, 1995, and 1996.

Catches of late-fall fry were observed in April and May of 1993 and in May of 1995 (both wet years), but absent during the spring of 1994, a critically dry year. November, December, and January catches of yearlings were high in the fall of 1994 (1995 field season), indicating that in drier years the majority of late-fall move through the lower Sacramento River as yearlings. High numbers were observed in November of the 1994 field season, earlier than observed in the 1995 field season (January, 1995). Potentially, the high flows in the spring of 1993 moved the fish into the lower Sacramento River as fry and contributed to the early peak of yearlings observed that fall. The pattern appears different in the drier years, with no fry observed in the lower Sacramento River during the spring and later peaks of late-fall observed the following fall. This pattern may be more pronounced due to the negative effects of high temperature on salmon survival. The high flows during December and January of the 1996 field season produced high catches of late-fall yearlings (1995 brood year). A single 1996 brood year fry was captured in the spring, indicating fry movement as well during the season.

Delta Beach Seine
(North, Central and South)

Delta beach seining was conducted weekly from August 1, 1995, through July 31, 1996, in the North, central and South Delta. A total of ten North Delta sites, ten central Delta sites, and nine South Delta sites were sampled each week (Figures 2 and 4). Between October and April an additional set of seine sites were sampled five days a week. The additional seine sites consisted of two sites on the lower Sacramento River, three new sites, and three sites in the North Delta. This seining was done in addition to normal sampling to capture winter run fry as they enter the Delta.

Raw catch and catch per cubic meter (CPM^3) of each race in the Delta is shown in Table 3. Figure 14 illustrates catch per cubic meter by day (by race) for the Delta seine sites, along with the Sacramento River flow at Freeport. This presentation indicates relative abundance of each race over time and their response to flow events.

A total of 17,907 fall/spring juveniles were captured in the Delta between December 14, 1995, and July 3, 1996, with a peak monthly CPM^3 of 1.67 in February (Table 4). The size of the fall/spring run captured ranged from 29 mm to 133 mm fork length. The peak emigration period occurred in February consisting mostly of fry during a period of high flows (Figure 14).

There were 139 winter run juveniles captured in the Delta beach seine between December 14, 1995, and April 4, 1996. Size ranged between 53 and 120 mm and averaged 84 mm. More than half of these fish (73) were captured in December following winter flow events.

A total of ten yearling sized late-fall were recovered in the Delta area between December 17, 1995, and February 6, 1996. The mean size of these yearling late-fall was 143 mm fork length. Four late-fall fry were captured during the spring of the 1995 field season. The 1995 brood year late-fall population migrated as fry and yearlings.

Nine late-fall fry from the 1996 brood year were captured in the spring between April 23 and July 23, 1996. Fork lengths ranged from 37 to 53 mm and averaged 43 mm.

Figure 15 displays the 1980 through 1996 comparison of the lower Sacramento, North, and central Delta average salmon catch per haul between January and March. Mean catch between January and March during the 1996 field season was above normal.

Past information has shown catch per seine haul in the northern Delta to be correlated to flow at Freeport (United States Fish and Wildlife Service, 1995). Mean January through March CPM^3 was plotted with mean February flow on the Sacramento River at Freeport between 1985 and 1996 in Figure 16. This relationship shows the importance of the Delta to juvenile salmon during high flow years.

Table 3. Monthly abundance (total number caught) and catch per cubic meter of fall/spring, winter, and late-fall run chinook salmon in the central, South, and North Delta beach seine during the 1996 field season.

Month	Catch Fall/spring	Catch per cubic meter	Catch Winter	Catch per cubic meter	Catch Late-fall	Catch per cubic meter
Sep	0	0	0	0	0	0
Oct	0	0	0	0	0	0
Nov	0	0	0	0	0	0
Dec	1261	0.13288	73	0.01129	6	0.00187
Jan	3159	0.44819	39	0.00562	2	0.00034
Feb	7927	1.66917	20	0.00686	2	0.00103
Mar	4724	0.83426	5	0.00101	0	0
Apr	720	0.1362	2	0.00066	1	0.00017
May	106	0.02208	0	0	7	0.00064
Jun	6	0.00111	0	0	0	0
Jul	4	0.00158	0	0	1	0.00029
Total	17,907		139		19	

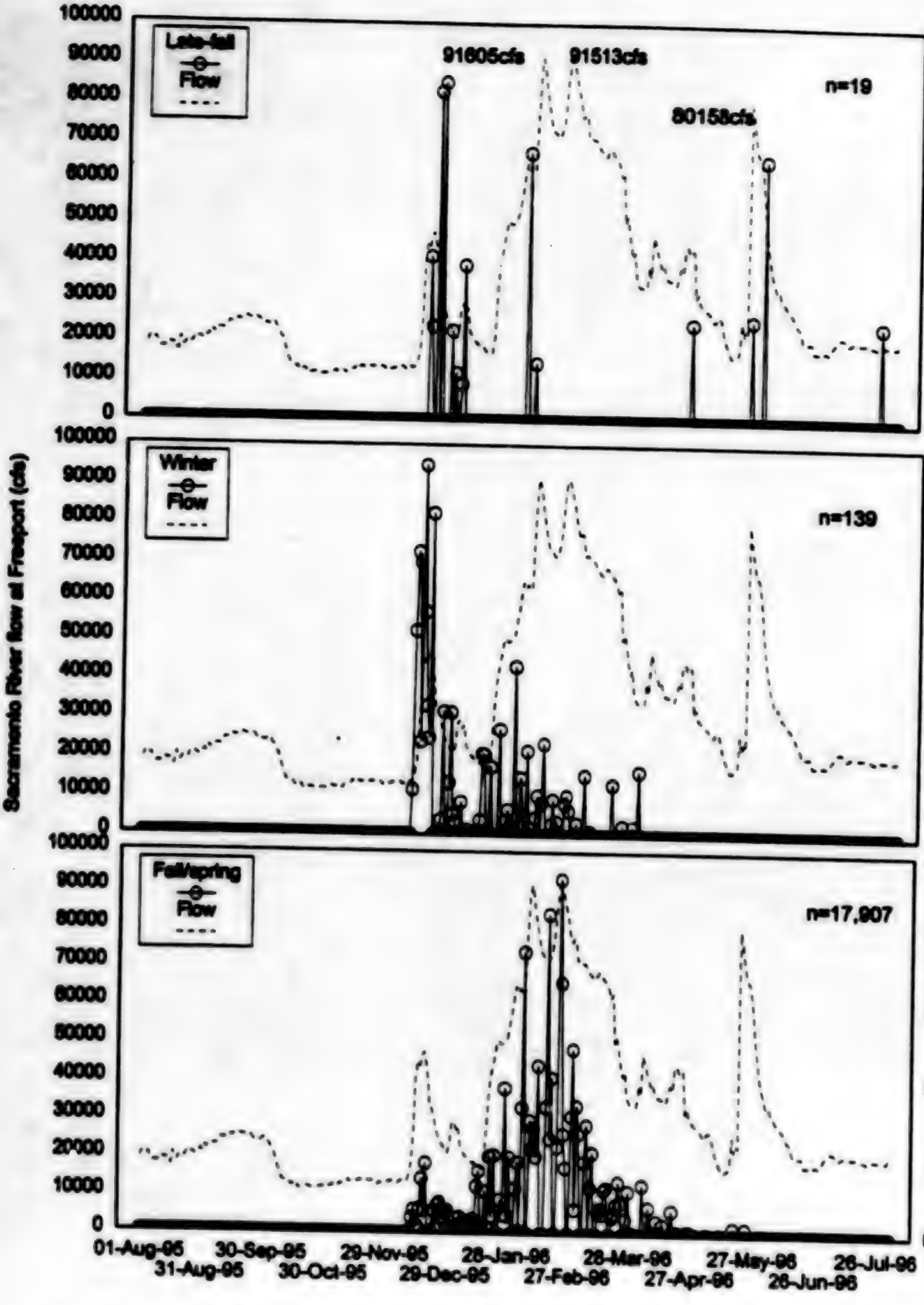


Figure 14. Catch per cubic meter of chinook salmon by race in the North, central and South Delta seine. Flow information from Freeport was incomplete throughout the 1996 field season, with no information between November 7 and December 20, 1995.

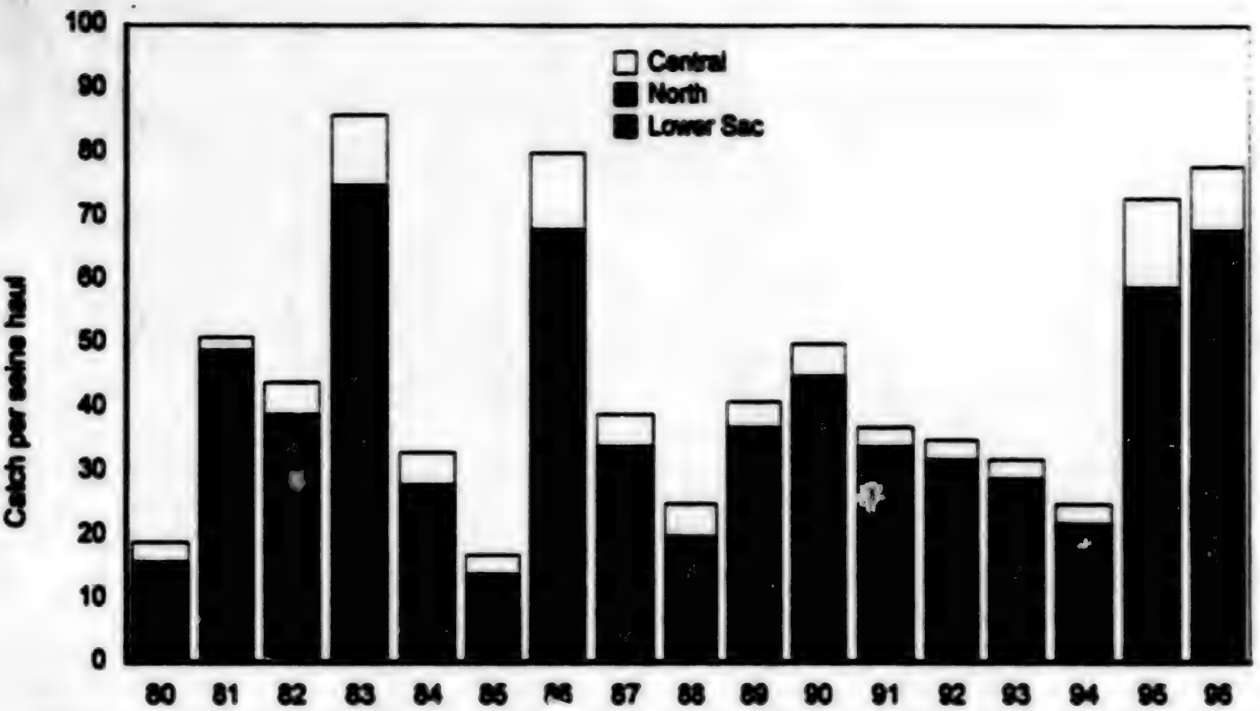


Figure 15. January through March average catch per seine haul between 1978 and 1996 of chinook salmon juveniles in the lower Sacramento River, North Delta, and central Delta. No sampling was done in the lower Sacramento River during 1980.

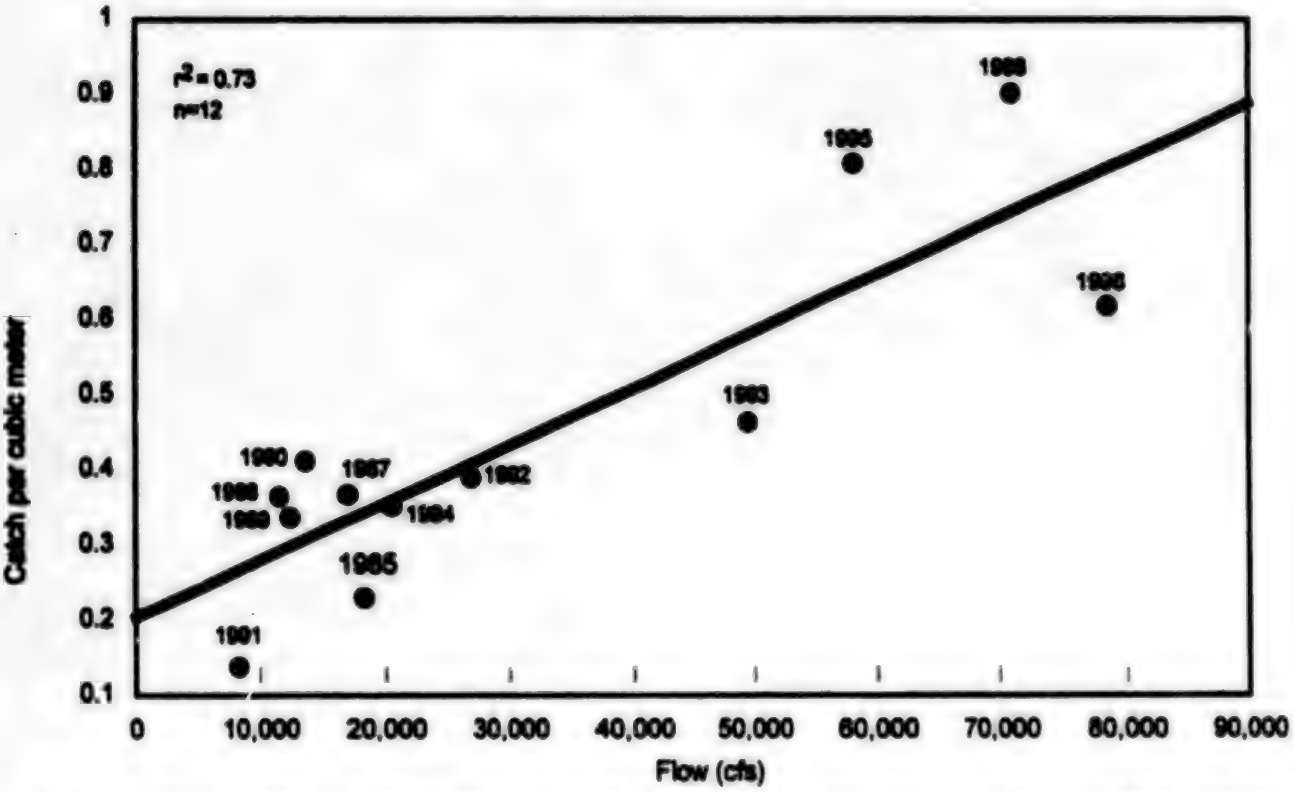


Figure 16. Mean catch per cubic meter in the North Delta (January - March) versus February mean flow on the Sacramento River at Freeport between 1985 and 1996.

Lower San Joaquin River Seine

The San Joaquin River seining effort began in 1994 to document the timing and abundance of the out-migrating fall run juvenile chinook.

Nine seine sites on the lower San Joaquin River were sampled on a weekly basis between January 1 and June 30, 1996, catching a total of 19 juvenile salmon. Catch in 1995 using similar effort yielded 30 chinook between February 8 and June 6, 1995. Total catch in 1994 occurred all in April and consisted of 53 juvenile chinook (Figure 17). There does not seem to be a consistent pattern between increases in flow and catches in the beach seine at sites along the lower San Joaquin River (Figure 17).

One winter run sized chinook (109 mm) was captured on April 4, 1995, at Dos Reis on the San Joaquin River. While this fish was consistent with the size of other winter run captured in the Delta and Sacramento River (101 mm - 204 mm) it was likely a San Joaquin River fall run chinook, as winter run spawn in the Sacramento River system. This is one example of the drawbacks to using the growth criteria on salmon in the Delta.

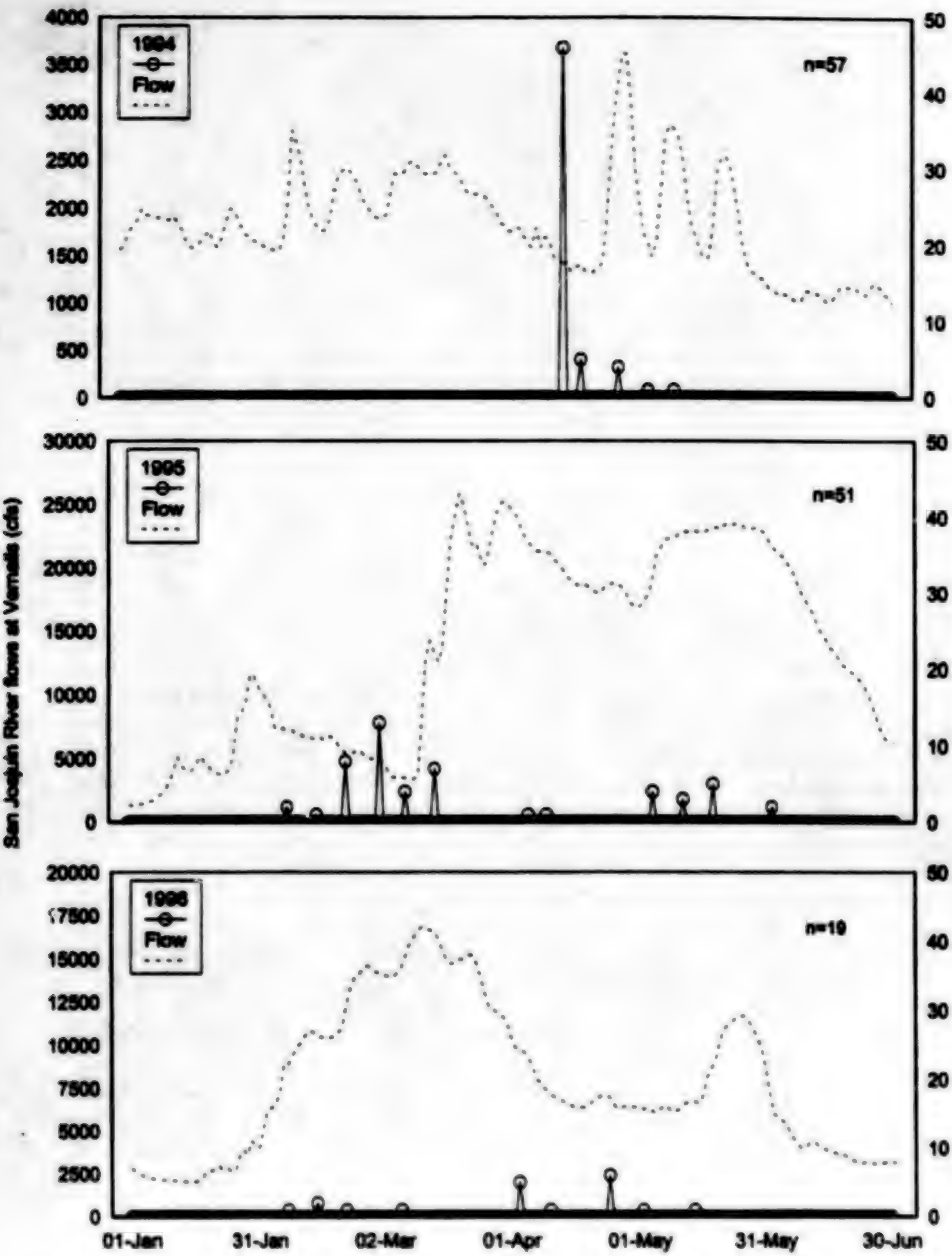


Figure 17. Lower San Joaquin River beach seine catches for 1994, 1995, and 1996. Flow information was taken at Vernalis.

Midwater and Kodiak Trawl at Sacramento

Midwater trawling has been conducted in Sacramento since 1988 in an attempt to index abundance and timing of juvenile chinook salmon entering the Delta. All sampling was done at river mile 55, approximately four miles downstream from Sacramento with the exception of 1990 when sampling occurred near the town of Courtland, approximately 21 miles downstream of the present site. Since 1995, Kodiak trawling using two boats, also has been utilized between October and April to capture larger, less abundant juveniles when vessels and crews have been available and when river flows were at safe levels. Both types of sampling gear were fished for ten 20 minute tows per day, three to seven days per week, targeting smolt sized juvenile chinook salmon that migrate in the deeper portions of the river channel. During the 1996 sampling season, midwater trawling occurred from August 1, 1995, to October 24, 1995, and April 1, 1996, to July 31, 1996, while Kodiak trawling was performed from October 25, 1995, to April 4, 1996. Flow information at Verona was obtained from the Department of Water Resources (rm 80).

A total of 11,341 fall/spring run were captured using the midwater trawl during the 1996 field season (Table 4). Midwater trawling started in August capturing yearling sized fall/spring run from the 1995 brood year. These fish were probably a continuation of the fall/spring run migration from the spring of 1995 (Figures 18 and 19). When trawling ensued during the spring of 1996 mostly smolt sized fish were captured (Figure 18). Size of capture ranged from 38 mm to 117 mm fork length. Captures occurred between August 7, 1995, and July 29, 1996. Density was highest in April and May.

A total of 34,051 fall/spring run were captured using the Kodiak trawl during the 1996 field season. The first emigration of fry was captured from the 1996 brood year which coincided with the first high flow event of the season (Figure 19). In addition, the Kodiak trawl fished during heavy outflow periods in the winter, yielding many fall/spring run fry. In January, as flows increased, catches of fall/spring fish also increased. The peak period of emigration was in early February which coincided with the first of the three high flow events for the season. During a three day period (February 5, 6, and 7), CPM^{a}'s for fall/spring were two to seven times higher than any other day during the season. The corresponding flows at Verona were high as well. Fork lengths ranged from 25 to 241 mm.

Because there was no midwater trawling between November and April, the out migration season for winter run was not effectively addressed by the midwater trawl.

Winter run were captured from December 15, 1995, to April 2, 1996, in the Kodiak trawl and first captured in December when peak flows for the season began. The last detection of winter run occurred during a period of decreasing flows (Figure 19). Highest monthly catches and CPM^{a} occurred in March (Table 4). Peak density in 1996 was also in March whereas in 1994 peak catches occurred in February, a critically dry water year. Size of capture during the 1996 field season ranged from 51 to 140 mm fork length.

Late-fall chinook were captured in August and September (one fish each month) in the midwater trawl. These fish were from the 1995 brood year. One fish from the 1996 brood year was captured in April. Twenty-seven late-fall run were captured in December and January in the Kodiak trawl. The peak catches occurred during first peak flow in December (Figure 19). Size ranged between 109 and 142 mm fork length.

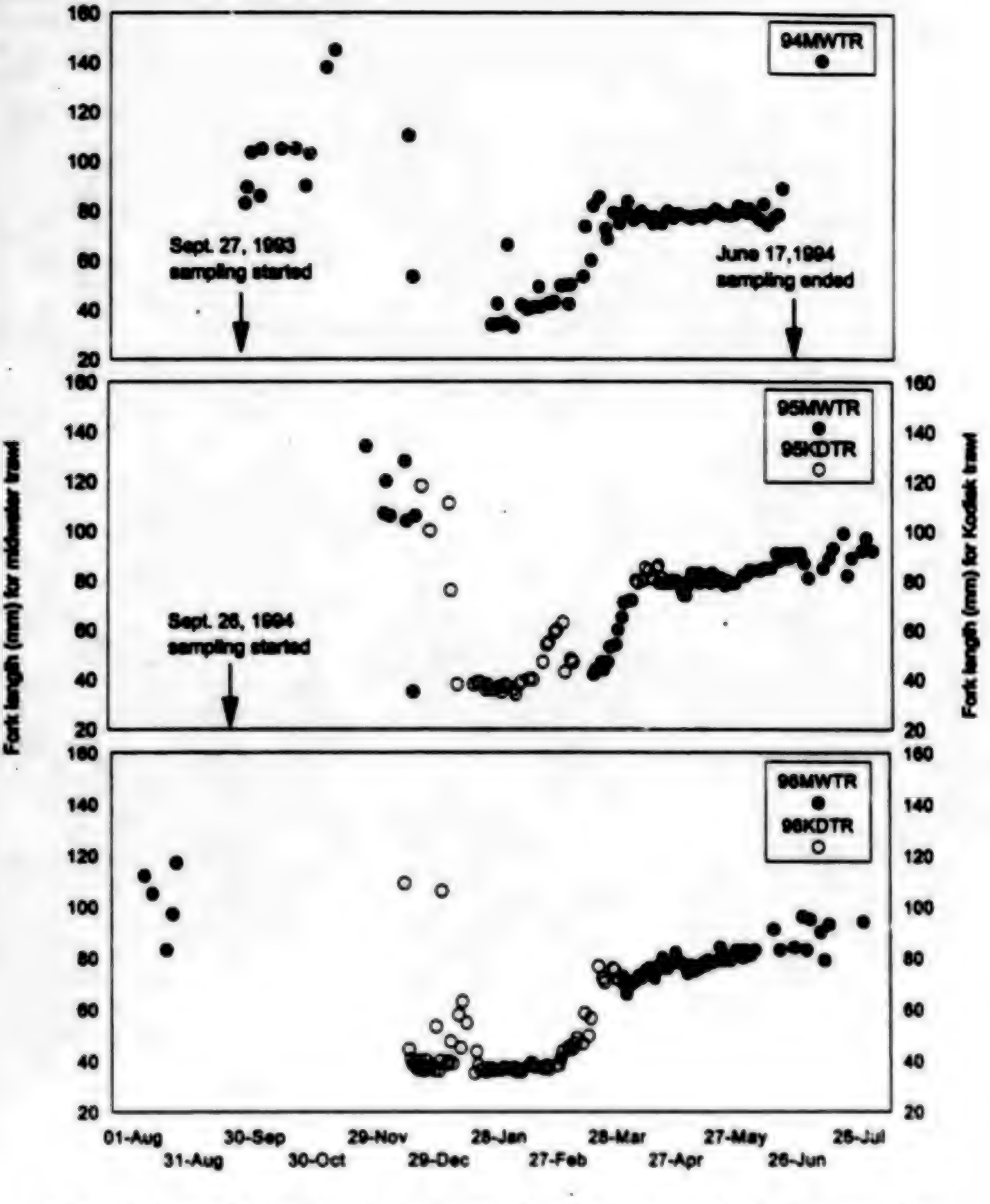


Figure 18. Average fork length per day for all races of chinook salmon captured in the Sacramento River midwater (MWTR) and Kodiak (KDTR) trawls (1994, 1995, and 1996). No Kodiak trawling occurred in 1994.

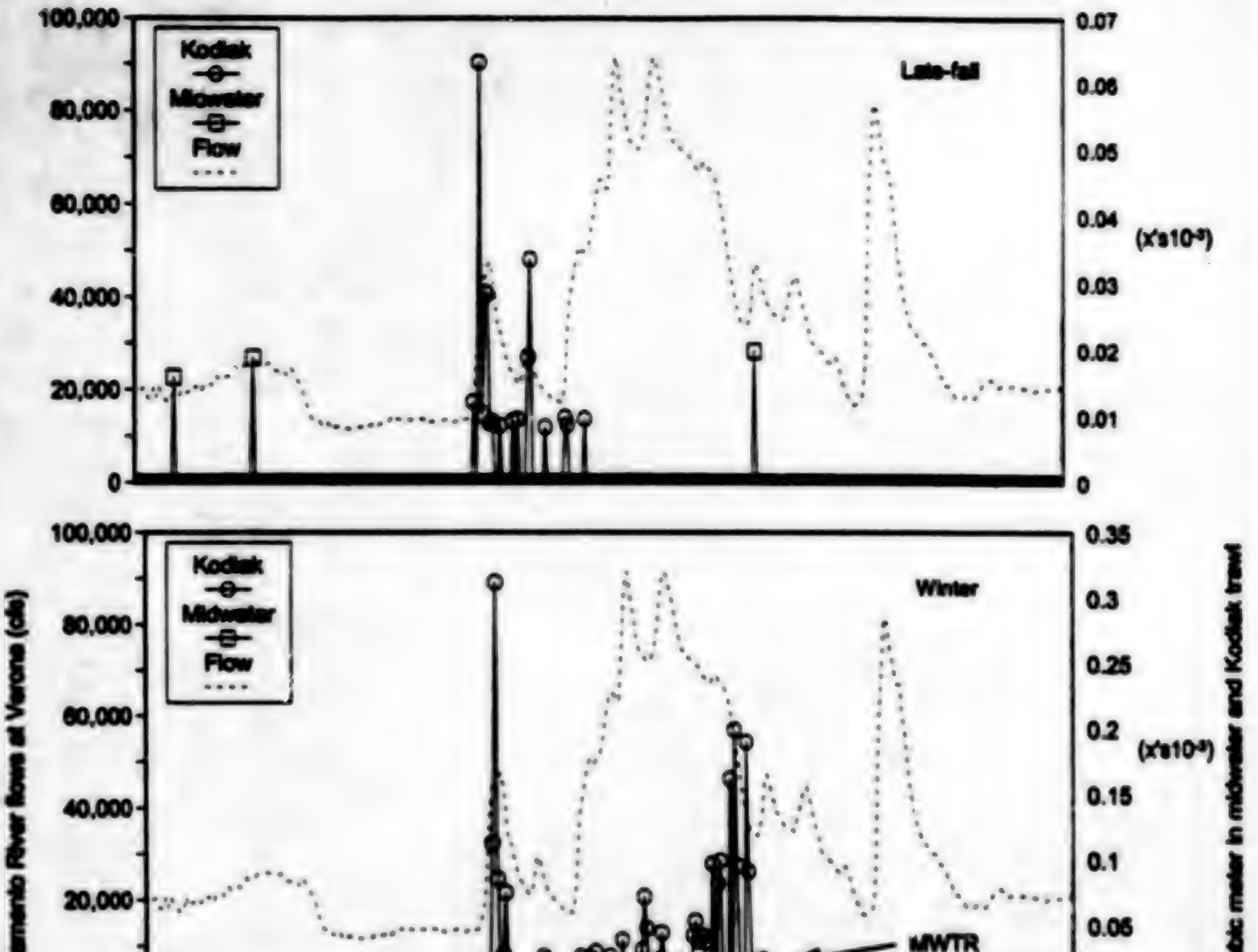


Figure 19. Daily catch per cubic meter in the Kodiak and midwater trawl at Sacramento during the 1996 field season.

Table 4. Mean fork length and catch per cubic meter x 10,000 of late-fall, winter, and fall/spring run chinook in the midwater and Kodiak trawl at Sacramento during the 1998 field season.

	MWTR	MWTR	MWTR	MWTR	MWTR	MWTR
Month	Catch Late-fall	Catch per cubic meter	Catch Winter	Catch per cubic meter	Catch Fall/spring	Catch per cubic meter
Aug	1	0.0159	0		6	0.0725
Sep	1	0.0125	0		0	
Oct	0		0		0	
Nov	NS	NS	NS	NS	NS	NS
Dec	NS	NS	NS	NS	NS	NS
Jan	NS	NS	NS	NS	NS	NS
Feb	NS	NS	NS	NS	NS	NS
Mar	NS	NS	NS	NS	NS	NS
Apr	1	0.0057	2	0.0113	5767	44.1839
May	0		0		5493	31.5145
Jun	0		0		62	2.3443
Jul	0		0		13	0.2288
Totals	3	0.034	2	0.0113	11341	78.344

	KDTR	KDTR	KDTR	KDTR	KDTR	KDTR
Month	Catch Late-fall	Catch per cubic meter	Catch Winter	Catch per cubic meter	Catch Fall/spring	Catch per cubic meter
Aug	NS	NS	NS	NS	NS	NS
Sep	NS	NS	NS	NS	NS	NS
Oct	0		0		0	
Nov	0		0		0	
Dec	17	0.07035	61	0.24944	669	2.52695
Jan	10	0.04266	31	0.1422	7456	35.2577
Feb	0		31	0.17018	21013	122.547
Mar	0		120	0.72301	2802	168.238
Apr*	0		3	0.6045	2111	512.389
May	NS	NS	NS	NS	NS	NS
Jun	NS	NS	NS	NS	NS	NS
Jul	NS	NS	NS	NS	NS	NS
Totals	27	0.113	246	1.889	34051	840.941

* Sampling only occurred April 1-4, 1998.

Figure 20 illustrates the mean catch per tow at Sacramento since inception of sampling in 1988. These catches are heavily influenced by Coleman National Fish Hatchery releases during the spring. Catches in 1996 were slightly below average. This could be due to the large portion of fry which emigrated from the system in the winter and or low survivability of Hatchery released fish.

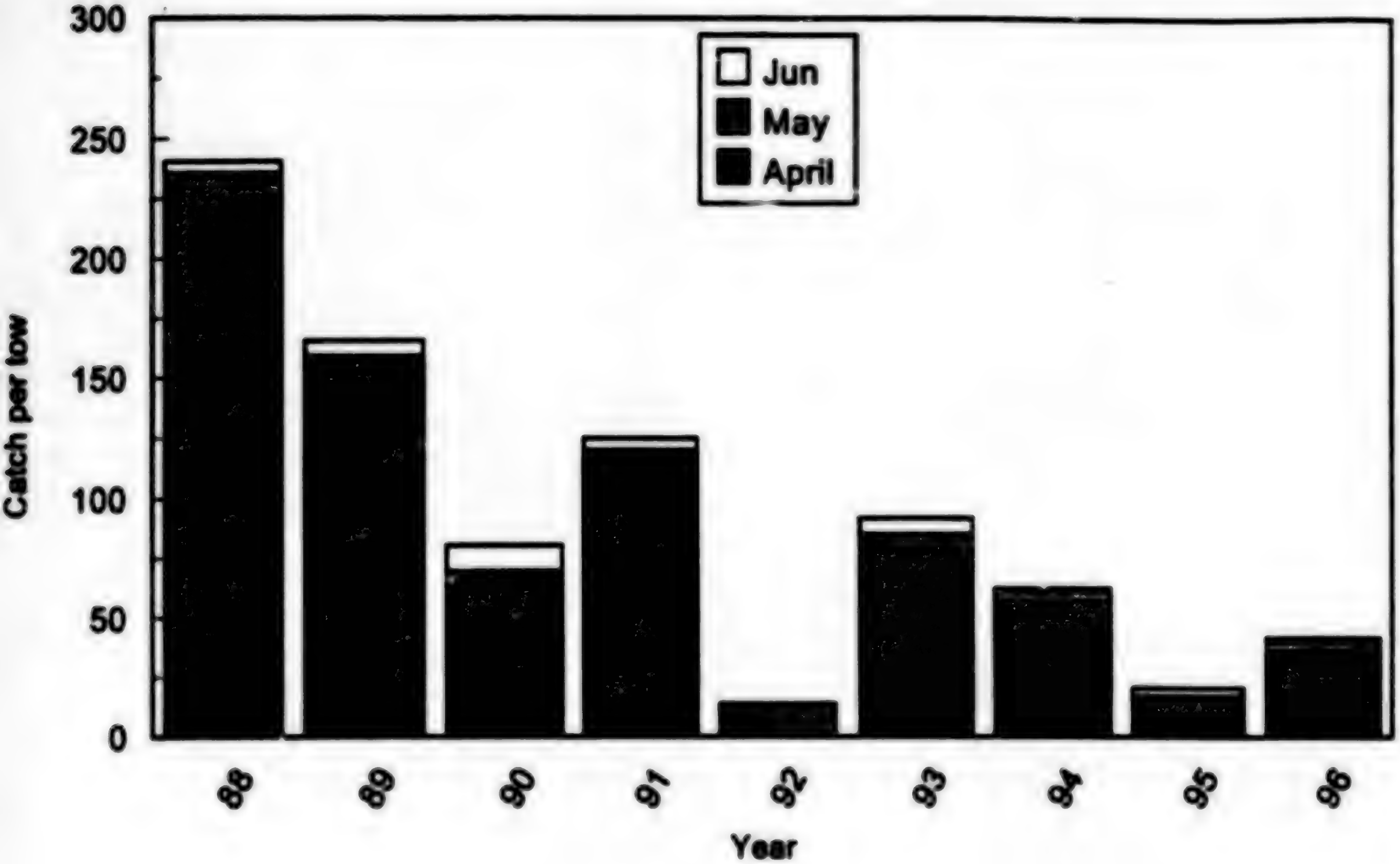


Figure 20. Mean catch of salmon smolts per 20 minute tow with the Sacramento midwater trawl in April, May, and June from 1988 to 1996. Trawling was done approximately 20 miles downstream in Courtland during 1990. No sampling was done in April of 1992.

Midwater Trawling at Chipps Island

Trawling at Chipps Island during the 1996 field season was conducted from August 2, 1995, through June 22, 1996, to increase our knowledge of the migration of juvenile salmon from the Delta. The sampling typically consisted of ten 20 minute tows done on a three to seven day a week schedule depending on the need to recover coded wire tagged salmon for survival studies.

As in past years, the majority of smolts migrated through the Delta in April and May, reflecting the high numbers of fall/spring run fish relative to the other races and the influence of the spring hatchery releases from Coleman National Fish Hatchery. In 1996, the mean juvenile chinook abundance in the western Delta at Chipps Island for the months of April, May, and June, was very close to the mean of the years 1978 through 1995. The mean catch per tow at Chipps Island for the months of April, May, and June was 20.5 in 1996 and the mean catch per tow for the years 1978 through 1995 was 19.6. The actual catches during April, May, and June were very close to the 1995 catches (Figure 21). Figure 22 represents the average daily fork length (mm) of all races of juvenile chinook captured at Chipps Island and the daily catch per cubic meter (logarithm base 10) of all races of chinook caught at Chipps Island. From August through December, the average daily fork length was generally higher than for those captured in January through June due to the presence of larger yearlings in the fall catch. Large numbers of fry were captured in late January and early February at Chipps Island. Spring catches consisted of mostly smolts. Catches by race are standardized by cubic meters of water sampled and provided on a daily basis in Figure 23.

A total of 33 late-fall yearlings of the 1995 brood year were captured at Chipps Island between September 1995 and February 1996. One fry from the 1996 brood year at thirty-five millimeters fork length was captured in May. Otherwise, the sizes ranged from 88-154 mm fork length. The highest relative density of late-fall as shown in Table 5, was in January. This is a month later than observed in Sacramento, again demonstrating that late-fall moved relatively quickly through the Delta (but not as fast as fall/spring smolts) in the fall/winter of the 1996 field season.

A total of 358 winter run were captured at Chipps Island in the 1996 field season. The first winter run capture during the 1996 field season at Chipps Island was December 20, 1995 (Figure 15). Peak captures were in March, with presence detected December through May. The fork lengths of these smolts ranged from 83 to 154 mm. The 1995 field season total winter run catch at this location was 312 and in 1994 it was only 47. The average catch per cubic meter x 10,000 for the months of January through April in 1996 was .2146 (Table 5), which is comparable to the 1995 figure of .2763. The 1994 average for this same time period was .0765. The 1995 and 1996 water years were both wet while 1994 was a critical water year.

A total of 17,132 fall/spring were captured at Chipps Island between August and July. The peak was in May, with 10,195 juvenile chinook captured. The sizes ranged from 30 mm to 258 mm fork length (Figure 22). Fry were observed December through March, with a peak in February and again in April and May. Yearling sized fish were captured August through November and smolts were captured March through June.

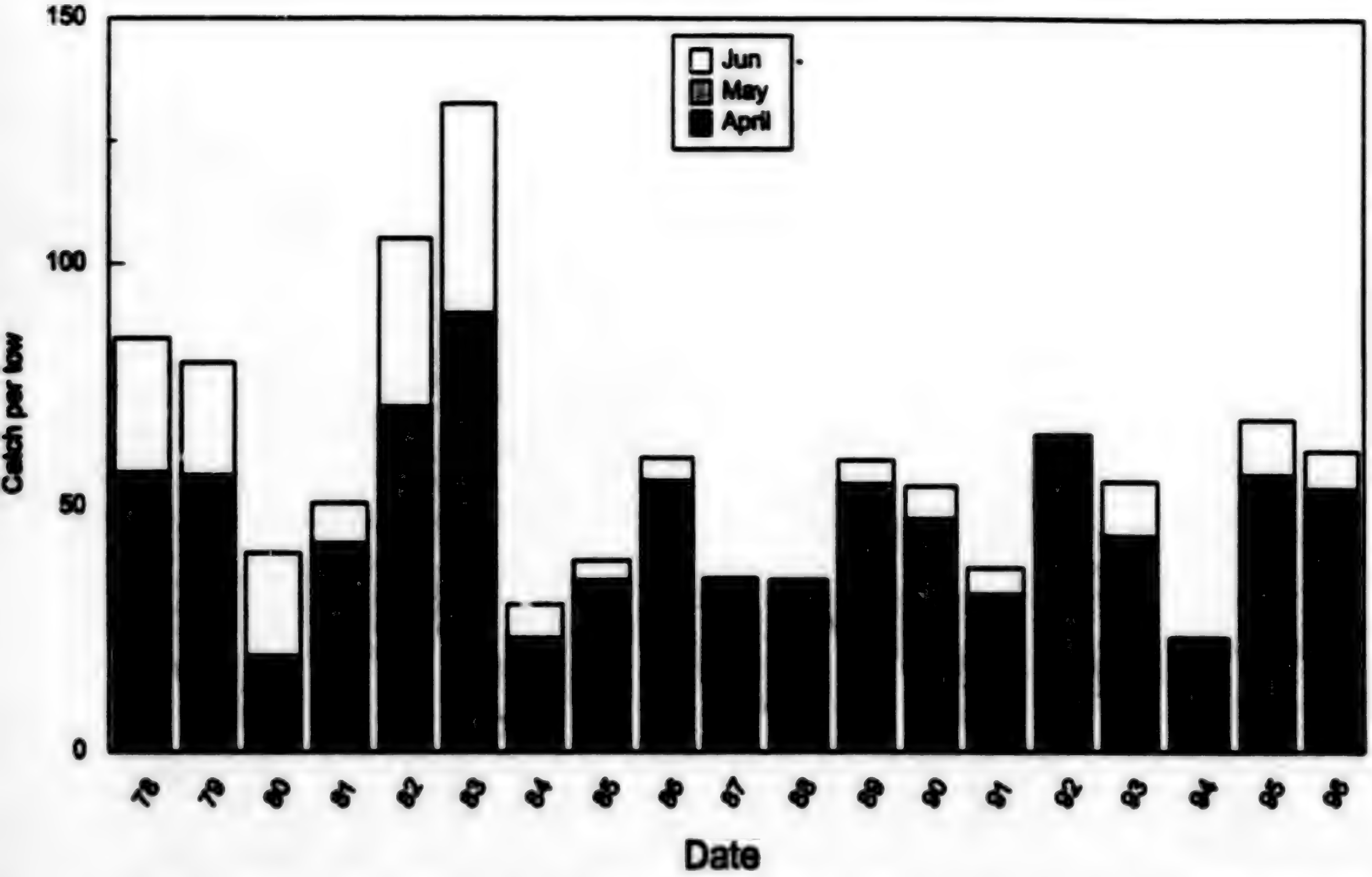


Figure 21. Mean catch of salmon smolts per 20 minute tow with Chipps Island midwater trawl in April, May, and June from 1978 to 1996.

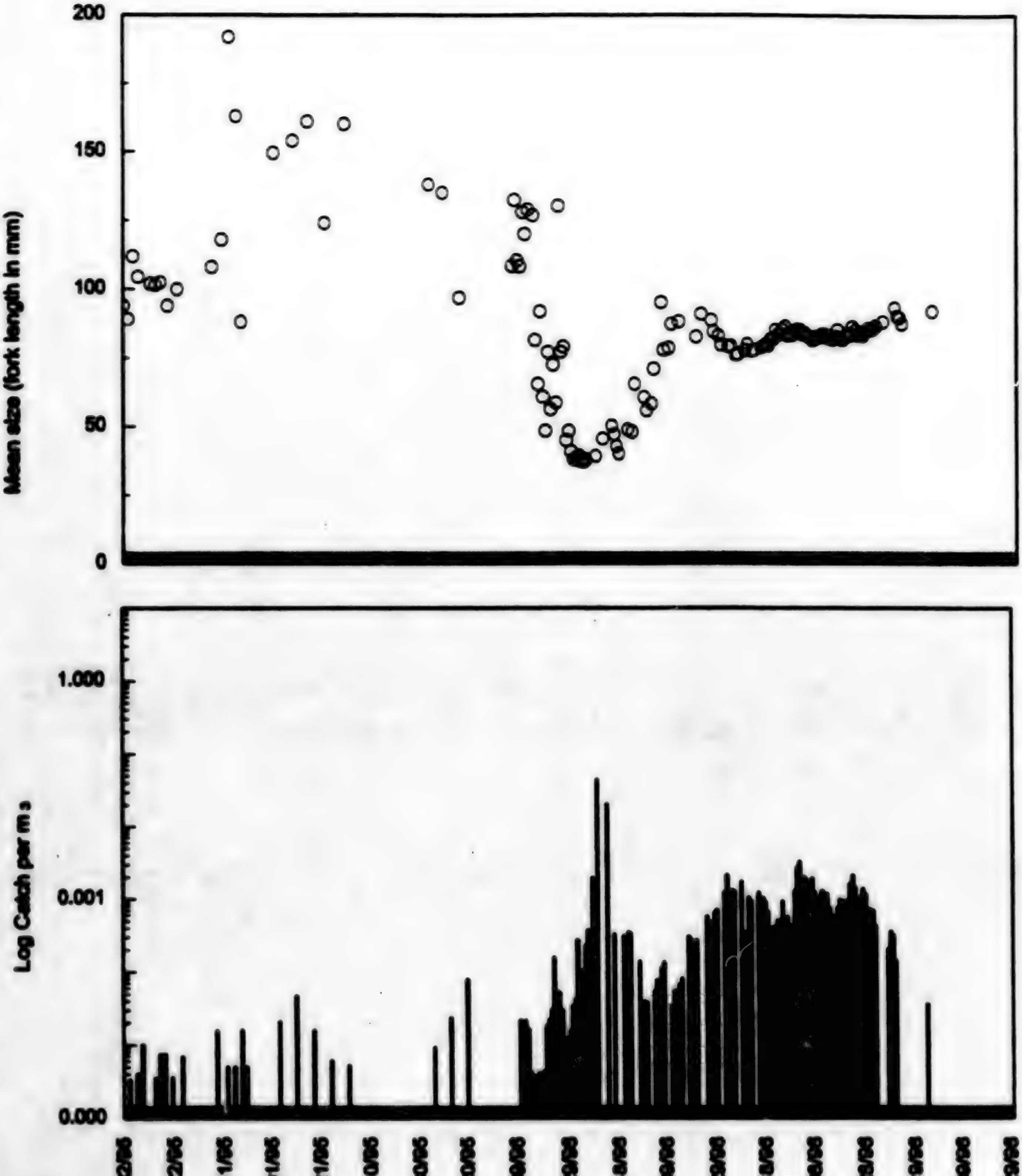


Figure 22. Mean size and log of catch per 20 minute tow at Sacramento between August 2, 1995, and July 29, 1996.

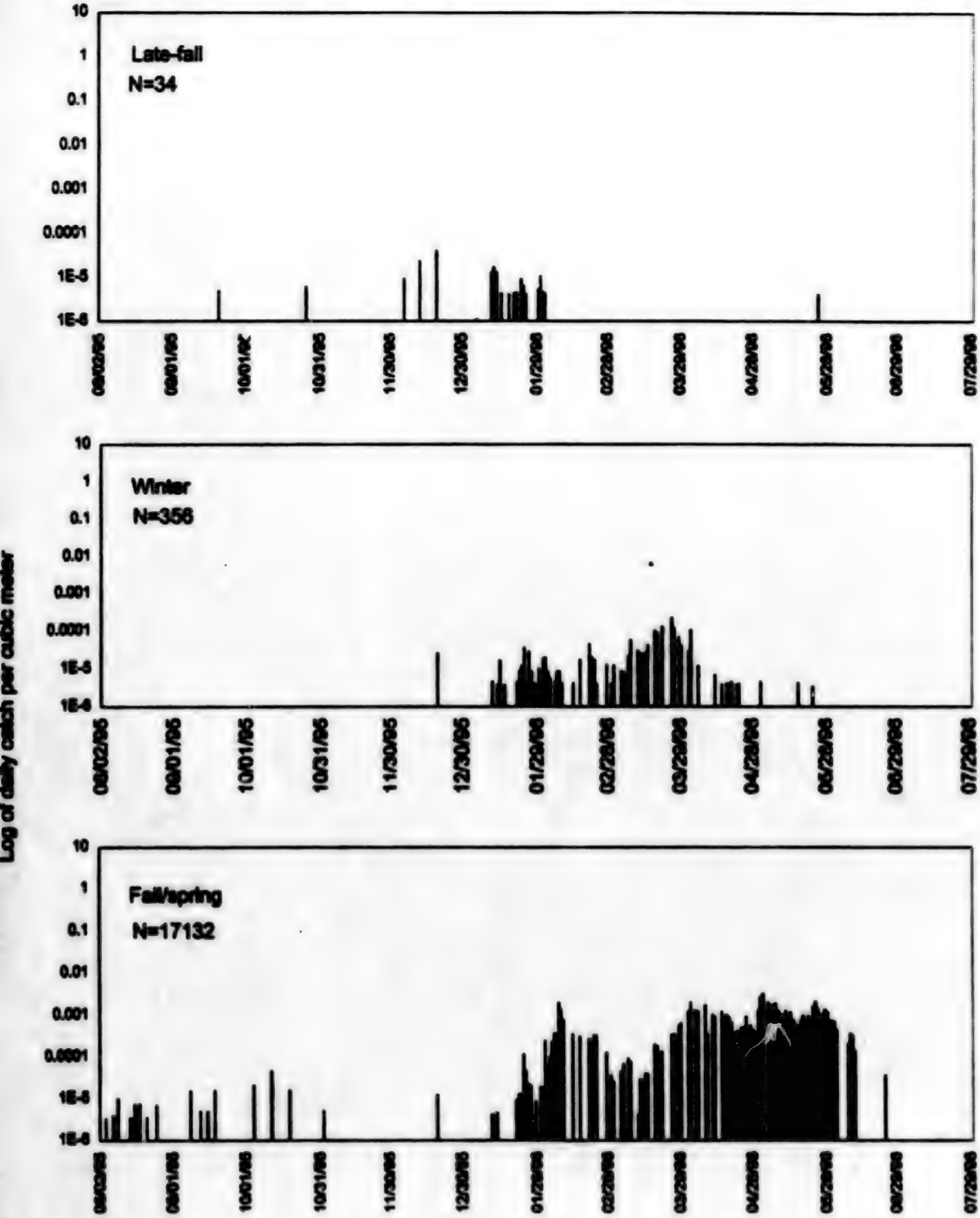


Figure 23. Daily catch per cubic meter (log) of each species in the midwater trawl at Chipps Island during the 1996 field season.

Table 5. Catch by month and catch per cubic meter x 10000 of each race of juvenile chinook caught in the Chipps Island midwater trawl during the 1996 field season.

Month	Late-fall Catch	Late-fall Catch per cubic meter	Winter Catch	Winter. Catch per cubic meter	Fall/spring Catch	Fall/spring Catch per cubic meter
Aug	0	-	0	-	14	0.0235
Sep	1	0.00633	0	-	8	0.06765
Oct	1	0.01543	0	-	15	0.18284
Nov	0	-	0	-	1	0.01313
Dec	10	0.16380	4	0.06395	2	0.03075
Jan	20	0.03935	38	0.06550	59	0.10031
Feb	1	0.00218	33	0.11223	1,578	3.66138
Mar	0	-	239	0.59482	688	1.58957
Apr	0	-	39	0.06582	4,233	9.35601
May	1	0.00462	3	0.00118	10,195	13.57709
Jun	0	-	0	-	339	1.50644
Jul	0	-	0	-	0	-
Total	34		356		17,132	

and June from 1978 to 1996 with the water year type included across the bottom of the figure. Most of the 1996 fish were captured in May, with very few caught in June. This was also the case in 1995. In 1994 and 1992, both considered critical water years, the peak in catch occurred in April. Prior to 1985, chinook catches were much more evenly distributed over this three month period.

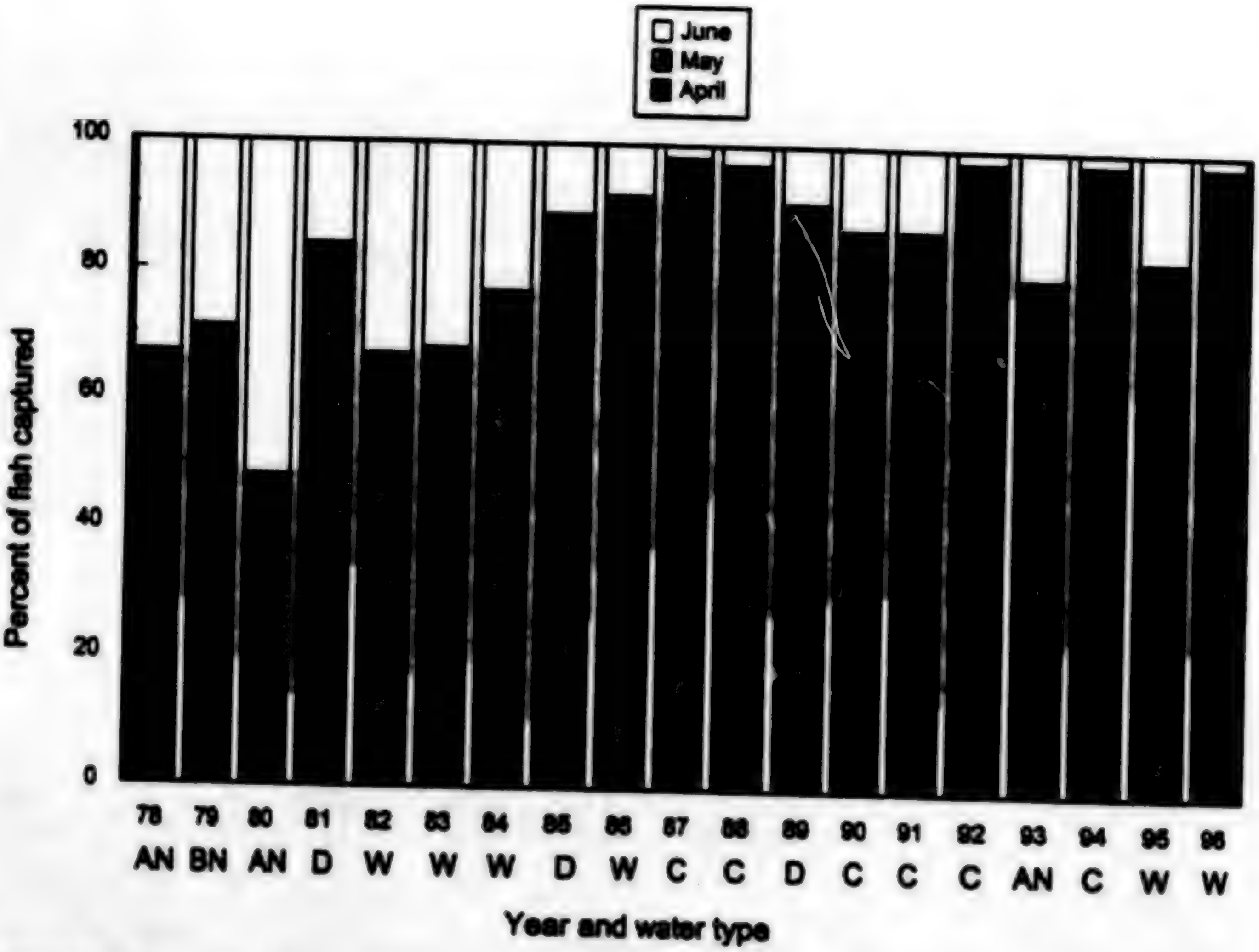


Figure 24. Percent of total midwater trawl chinook smolt catch in April, May, and June at Chipps Island from 1978 to 1996. Water year types also are indicated (AN = above normal, BN = below normal, D = Dry, W = Wet, C = critical).

Absolute Abundance Estimates

To estimate the absolute abundance of out migrating juveniles in 1996 the mean trawl recovery rate between 1980 and 1995 (excluding 1987) was used.

The yearly mean trawl recovery rate is calculated by averaging trawl recovery rates for each tag group within a year.

The trawl recovery rate at Chipps Island was calculated based on the following formulas:

Trawl recovery rate = # captured at Chipps / # available for capture at Chipps, adjusted for time,

- the # captured = the number of a particular tag code recovered at Chipps Island,
- the # available for capture at Chipps adjusted for time = # surviving X fraction of time sampled,
- the # surviving to Chipps Island = recovery rate in the ocean fishery of the upstream tag group / recovery rate in the ocean fishery of the control group (Benicia, Port Chicago, or Ryde),
- and the recovery rate in the ocean fishery = expanded # of a of particular tag code recovered in ocean fishery/number released

If the control groups (Port Chicago or Benicia) have unusually low ocean survival rates the resulting trawl recovery estimate will be greater than 1.0. To prevent this, Ryde which is approximately 25 miles upstream was used at times as a control group. Trawl recovery values between 1980 and 1995 (excluding 1987) ranged between .0034 to .0329 and averaged .0104 (see Figure 25 and Appendix 1). No control releases were done in 1987 thus no estimate of trawl recovery rate was obtained for that year.

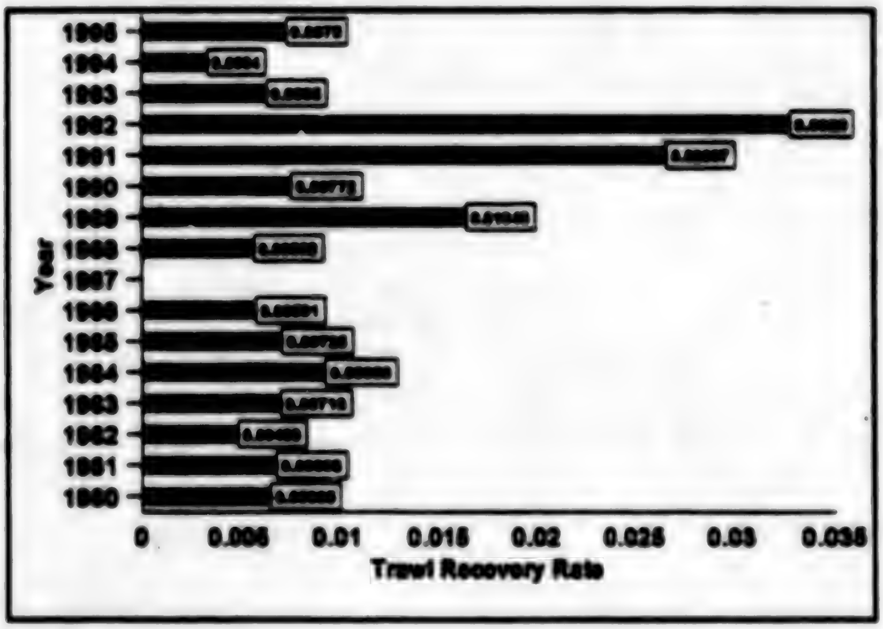


Figure 25. Recovery rate of the midwater trawl at Chipps Island between 1980 and 1995. There were no control releases in 1987.

Groups with survival greater than 1.0 were not used in the calculation of trawl recovery rates because they were outside the boundaries of reasonable estimates. Survival values equal to 0.0 were not used as well, because recovery rates can not be estimated using null values. Although there are many assumptions associated with these estimates of trawl recovery, they do provide an assessment of trawl recovery at Chipps Island.

Because ocean recovery data for the 1996 field season will not be available until ample time is given for recoveries, the recovery rate used in this report was based on the average recovery rate between 1980 and 1995 (excluding 1987).

Juvenile fall\spring run chinook estimates for the season, consisting of fry captures during the winter, and smolt captures during the spring (between August 1, 1995, and July 31, 1996) totaled 15,980,777. This estimate is slightly higher than the 1994 estimate (Table 6), and lower than the 1995 estimate.

The juvenile winter run estimate between December 1995 and May 30, 1996, was 477,860. As was the case with fall/spring fish, the 1996 brood year estimate for winter run was higher than the 1994 brood year but lower than the 1995 brood year estimate.

A total of 33 late-fall were captured at Chipps Island between August and January of the 1996 field season representing the 1995 brood stock. One 1995 brood year late-fall fry was captured during May of the 1995 field season. Combining these two seasons catches gives an estimated abundance of 120,663 late-fall for the 1995 brood year.

Only one 1996 brood year late-fall was captured in the Chipps Island trawl during May bringing the abundance estimate to 726 fish. Because the majority of late-fall captured in the Chipps trawl are during the fall the following year, during the next field season, a complete estimate of the 1996 brood year will not be possible until results are in from the 1997 field season.

Absolute abundance for all years was also estimated by expanding juvenile catch at Chipps Island using the mean trawl recovery rate. Past expansions using the fraction of time and channel width sampled of coded wire tagged fish recovered at Chipps Island have estimated survival to be greater than 1.0 at times. This may indicate that, due to the tidal flux at Chipps Island, we are sampling the same group of fish repeatedly (fish may be moving past Chipps Island more than once due to tidal effect). This would overestimate survival. Sampling is also done during the day which typically yields higher catches than at night (Wickwire and Stevens, 1986) which would also bias the survival estimates high. It is assumed for expansion that the coded wire tagged smolts passing by Chipps Island are equally distributed in both space (across the channel) and time.

Appendix 1 shows total catch, fraction of time sampled, and the corresponding abundance estimates based on the overall trawl recovery for the years 1980 to 1995 (excluding 1987). It is likely that efficiencies during the wet years such as 1995 are relatively low due to high outflow. Ocean data in future years will provide information to evaluate this possibility.

Table 6. Catch, trawl recovery rate, and estimated abundance of fall/spring, winter, and late-fall chinook smolts captured at Chipps Island 1994 - 1996. Late-fall estimates are calculated from two sampling years catches because outmigraton ocurrs during the summer as fry and early winter as smolts. Results from the 1996 sampling year for late-fall estimates can not be obtained until results of 1997 field season are calculated.

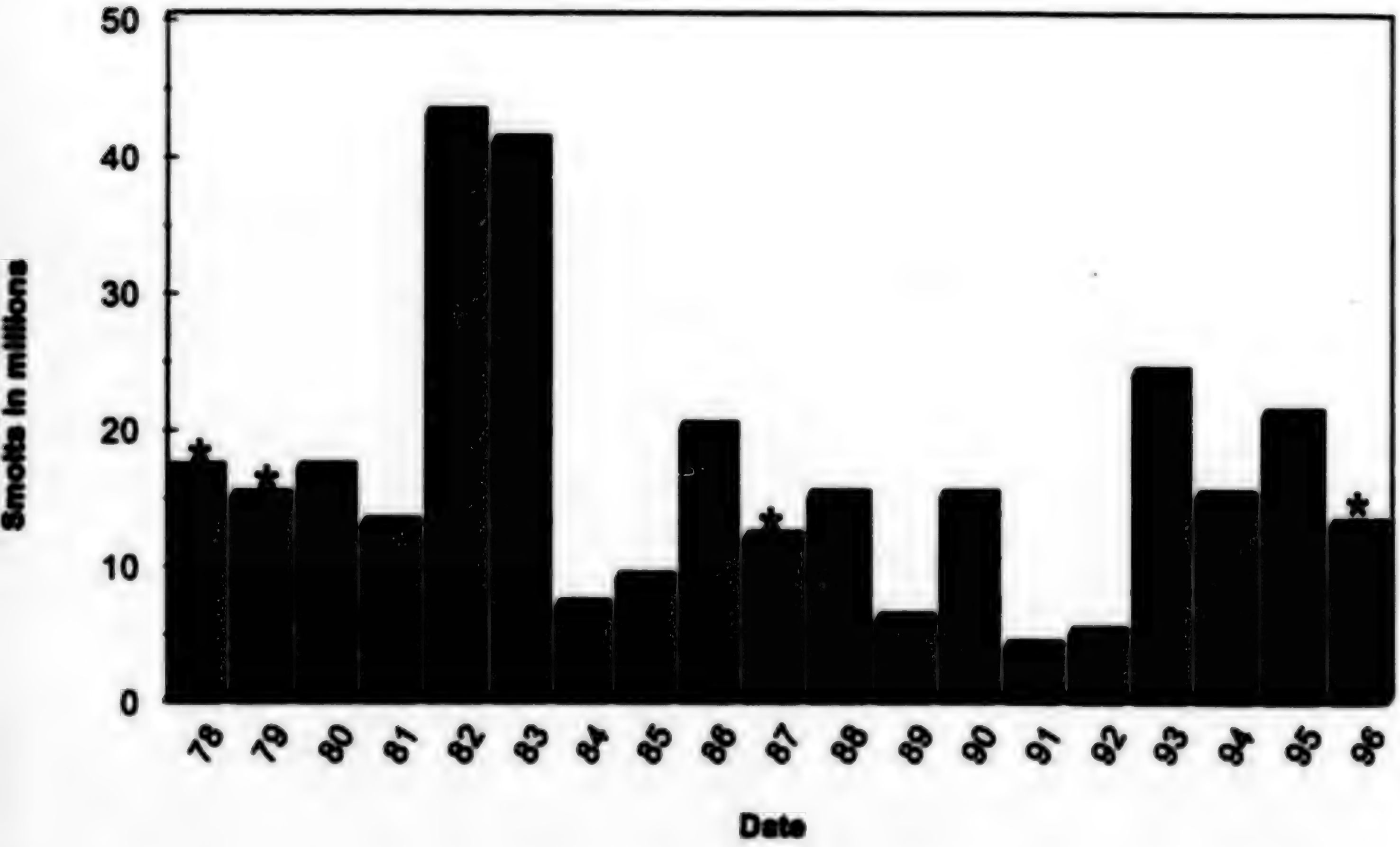
Year/race	Catch	Trawl Recovery Rate	Estimated Abundance
1994 Fall/spring	5,898	0.0034	14,776,389
1995 Fall/spring	19,700	0.0075	22,724,486
1996 Fall/spring	17,092	0.0104	15,980,777
1994 Winter	47	0.0034	201,613
1995 Winter	312	0.0075	623,103
1996 Winter	358	0.0104	477,880
1994 Late-fall	0 (fry) 88 (yearling)	0.0034 0.0075	0 106,950
1995 Late-fall	1 (fry) 33 (yearling)	0.0075 0.0104	989 119,673 120,662
1996 Late-fall*	1	0.0104	726

* This estimate only includes fry captures during the 1996 field season. A complete estimate will be made after the 1997 field season.

Figure 26 graphs yearly abundance estimates at Chipps Island between April 1 and June 30 from 1978 to 1995 using the trawl recovery rate for each year and if not available, the mean from 1980 to 1995 (excluding 1987). This graph provides a general index of the absolute production of chinook passing Chipps Island between between April and June from 1978 to 1995.

As discussed previously, catch per cubic meter at Chipps Island of smolts between April and June is significantly correlated with mean flow at Rio Vista (cfs) between 1978 and 1996 (Figure 27). This relationship shows that salmon smolt density increases during higher outflow.

If the mean density of smolts captured between April and June is divided by the trawl recovery rate for each year and plotted with flow, the relationship is improved (Figure 28), indicating that trawl recovery rates likely vary between years. Correcting for these differences in recovery rates improves the observed relationship and validates the use of this methodology.



* = used mean trawl recovery between 1980 and 1995 (excluding 1987)

Figure 26. Absolute estimates of smolt abundance at Chipps Island between April 1 and June 30 from 1978 to 1995 using trawl recovery rates calculated from ocean recoveries.

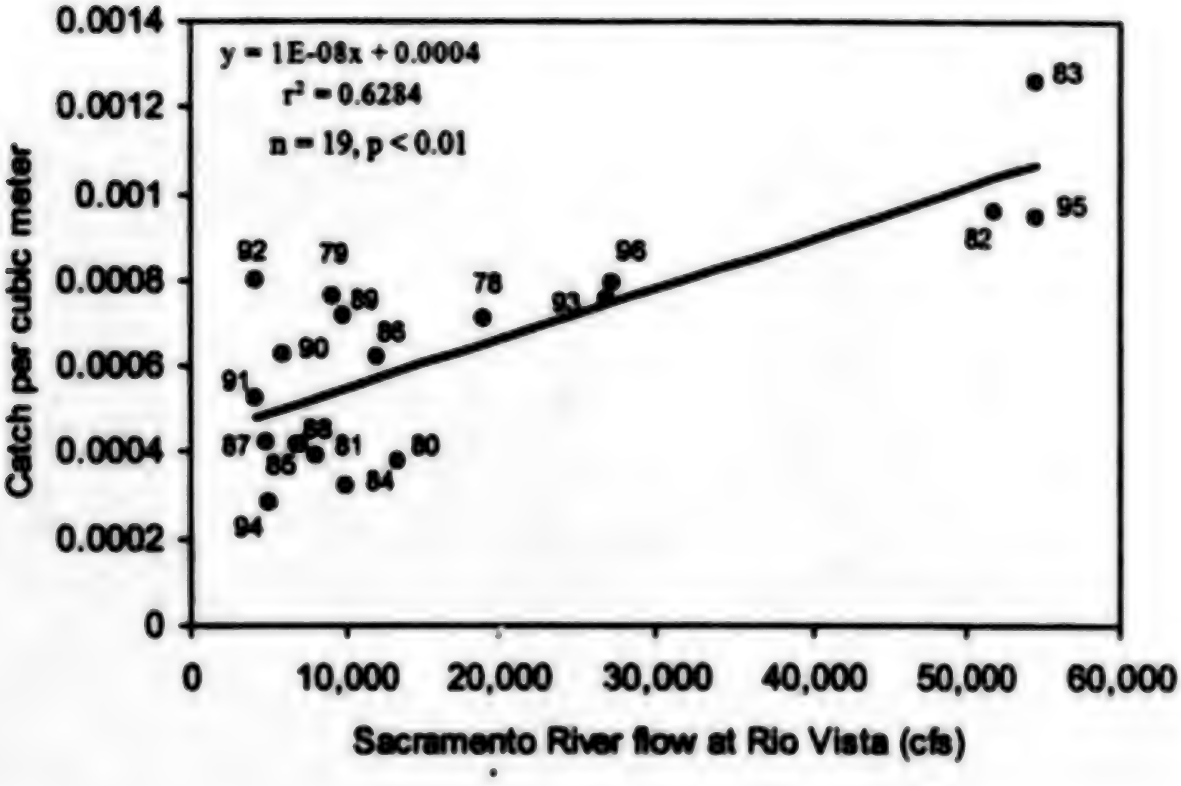


Figure 27. Mean catch of unmarked chinook salmon smolts per cubic meter in the midwater trawl at Chipps Island between April and June of 1978 to 1996 versus mean daily Sacramento River flow at Rio Vista between April and June in cfs.

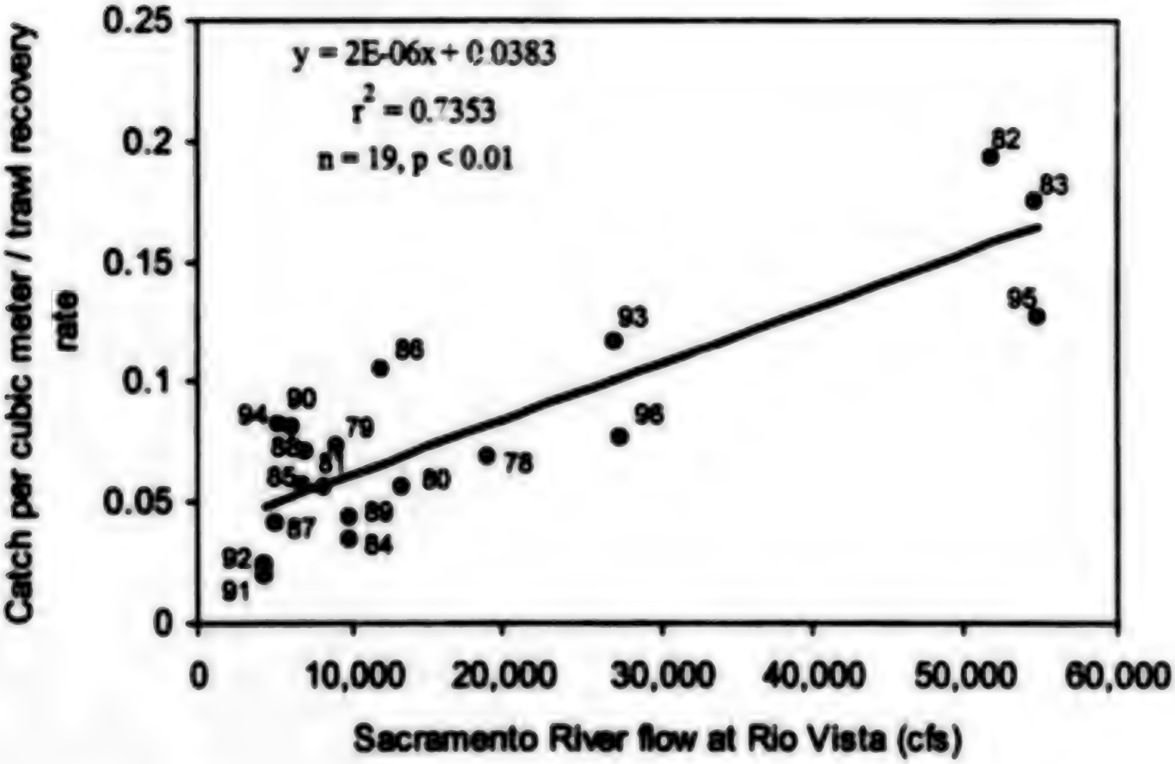


Figure 28. Catch of unmarked smolts per cubic meter at Chipps Island divided by the recovery rate based on CWT studies versus mean daily flow at Rio Vista (April-June) in cfs, from 1978 to 1996. Mean recovery rates for years 1980 to 1995 (excluding 1987) were used as recovery rate during 1978, 1979, 1987, and 1996 due to lack of control releases and or data availability.

Mark and Recapture Experiments

During the winter of 1995-96 and the spring of 1996, mark and recapture experiments using coded wire tagged (CWT) juvenile salmon were conducted to refine our understanding of their survival through the Sacramento and San Joaquin Deltas. The specific questions we attempted to address with mark and recapture studies in 1996 were:

a) using late-fall run smolts as surrogates for winter run:
   Can we verify that diversion of smolts from the mainstem Sacramento River into the interior Delta (via Georgiana Slough) reduces survival and determine to what magnitude? Is it similar to that observed for fall run even though the late-fall run fish are larger and temperatures at this time are cooler?

b) using fall run smolts in the San Joaquin River and Delta:
   What is the survival of salmon smolts migrating down the San Joaquin River released at Mossdale and Dos Reis under high flow conditions? Can the benefits of a barrier at the head of Old River be estimated (if one could be operated at high flows)?

c) using fall run smolts in the Sacramento River and Delta:
   What is the survival of salmon smolts migrating from Sacramento to Chipps Island during the spring of 1996 (high flow conditions) and how does it compare to survival in past years?

The survival index ($\hat{s}$) is estimated by dividing the number of a particular tag group recovered by midwater trawl at Chipps Island by the total number of that tag group released, corrected for the fraction of time and channel width sampled at Chipps Island (USFWS, 1987). Although sometimes referred to as survival, this is actually only a relative index of survival. Absolute survival can be estimated over a portion of the Delta by comparing relative survival estimates of two or more releases (upstream and downstream) made at the same time.

Late-fall run experiments:

Studies conducted with smolt sized fall run fish have shown that smolts diverted into the central Delta exhibit lower survival than those that remain in the Sacramento River (USFWS, 1993, 1994 and 1995). These experiments have historically been conducted in April and May, when hatchery reared fall run chinook generally reach smolt size (>70mm), yet before river temperatures become too warm. Winter run, however, which are federally listed as endangered, experience relatively cool water temperatures in the Delta, and may be less vulnerable to predation than fall run fish due to their larger size at the time of their outmigration. Late-fall run smolts have been used since 1993 as a more representative surrogate for winter run because of their similar (larger) size, and because overlap in their migration periods exposes them to cool water temperatures (≤ 60°F).

Methods

In 1996, groups of tagged late-fall run smolts from Coleman National Fish Hatchery (CNFH) were released on the mainstem Sacramento River above the confluence with Georgiana Slough (at Courtland), directly into Georgiana Slough, and below the confluence with Georgiana Slough (at Ryde), on January 9, 10, and 11, respectively (Figure 29). Recoveries were made at Chipps Island and at the state and federal salvage facilities in the south Delta. In future years, recoveries will be made in the ocean fishery, and will provide an independent means of verification for these results.

Results

Survival to Chipps Island: Similar to results of previous experiments using fall run smolts, survival index was considerably better for fish using the mainstem Sacramento (Ryde release, 0.66) than for those migrating through the central Delta (Georgiana Slough release, 0.17) as a pathway to the ocean (Table 7). As in past years, this data supports the hypothesis that like fall run, winter run experience lower survival rates when diverted into the central Delta, even though water temperatures are lower during their migration period. However, fish released at Courtland had the highest index of the three releases, at 0.78. It is difficult to explain this result, given that these fish had to pass the mouth of Georgiana Slough, where presumably some fraction of the group would have been diverted into the central Delta, and this fraction should have experienced a lower survival rate similar to that of the Georgiana Slough group. These results suggest that perhaps only a small percentage of this release group did migrate via Georgiana Slough or that sample variability resulted in a greater index. The Delta Cross Channel, which allows additional Sacramento River water into the central and western Delta, was closed for the protection of outmigrating winter run during the experiment, so that pathway into the interior Delta was not a factor. When the Delta Cross Channel gates are open, Sacramento River water is allowed an additional pathway to the interior Delta, which can significantly increase Qwest, a calculated measure of lower San Joaquin River flow at Jersey Point. Inversely, closure of these gates can restrict this Sacramento River flow, and Qwest may be decreased as the net flow of water moving towards the pumps must come from the West San Joaquin River. This decrease may be particularly pronounced when south Delta export rates are high. Based on this and past CWT evidence of higher mortality rates of diverted smolts (USFWS, 1995), closure of the Cross Channel gates and measures to prevent smolts from entering Georgiana Slough should continue to be considered important components of the efforts to increase juvenile winter run chinook salmon survival through the Delta.

Table 7: Survival indices to Chipps Island, expanded recoveries at the CVP and SWP fish salvage facilities, and total percent salvaged for late-fall run CWT releases made in January 1996.

release date and site	release number	ave. size at release (mm)	truck temp. (F)	river temp. (F)	survival index	expanded CVP recoveries	expanded SWP recoveries	total % salvaged CVP+SWP
Jan 9 Courtland	34,981	131	53	52	0.78	72	469	1.55%
Jan 10 Georgiana Sl.	33,670	125	55	52	0.17	180	588	2.28%
Jan 11 Ryde	30,494	122	52	51	0.66	12	0	0.04%

To make valid comparisons of results from one experiment to the next, we use the ratio of survival indices between the Georgiana Slough and Ryde groups. The Ryde groups provide a control or index of Sacramento River survival under the environmental conditions present at the time, while the

Georgiana Slough group then provides the survival of the fish relative to the Sacramento River group, which migrated via the interior Delta during the same period. Since the recovery period is the same, variables such as trawl efficiency are factored out, and these ratios can be compared among years, even though factors such as environmental conditions may differ. The Georgiana Slough to Ryde ratio for the 1996 late-fall run experiment falls within the range of those obtained for past experiments using late-fall run fish and is very similar to the 1994 ratio, when the export to inflow (E/I) ratio was also very similar, but the cross channel gates were open (Table 8).

Table 8. Survival indices for late-fall run CWT releases at Ryde (Sacramento River) and into Georgiana Slough in 1993-1996, and the Georgiana Slough to Ryde survival index ratios. Average combined CVP and SWP exports and average Sacramento River flow at Freeport during the 17 days following release, export/inflow ratio, cross channel gate status, and expanded CVP and SWP recoveries are also included.

Release Date	Georgiana Slough Survival Index	Ryde Survival Index	Georgiana/ Ryde Ratio	Total Exports	Sacramento Flow at Freeport	Export/ Inflow Ratio**	Cross Channel Gates	Expanded Georgiana Recoveries CVP / SWP	Expanded Ryde Recoveries CVP / SWP
1/10/96	0.17	0.66	0.26	11370	33680	34 %	Closed	180 / 586	12 / 0
1/4/95	0.06	0.39*	0.15	11763	62900	17 %	Closed	120 / 717	48 / 183
12/5/94	0.16	0.57	0.28	7075	19130	36 %	Open	48 / 39	0 / 6
12/2/93	0.28	1.81	0.15	10660	21440	47 %	Open	169 / 79	0 / 10

* Release was made at Isleton, approximately 8 miles downstream of Ryde.
** This ratio is defined as combined CVP and SWP exports over Sacramento River flow at Freeport

Furthermore, the ratios allow us to compare results of similar studies conducted in the spring using fall run fish, as even the differences in trawl recovery efficiency due to the size differences of fall and late-fall run test fish are factored out. Similar paired releases using fall run fish are shown in Table 9, and surprisingly, although river temperatures in the spring are considerably higher, fall run ratios are generally as high or higher than for the late-fall studies.

Table 9: Survival indices for fall run CWT releases at Ryde (Sacramento River) and into Georgiana Slough in 1992-1994, and the Georgiana Slough to Ryde survival index ratios. Also included are average fish length, river temperature at release and cross channel gate status. Such paired releases were not made using fall run in 1995 or 1996.

Release Date	Georgiana Slough Survival Index	average fish length (mm)	River Temp (F)	Ryde Survival Index	average fish length (mm)	River Temp (F)	Georgiana/ Ryde Ratio	Delta Cross Channel Gates
4/25/94	0.11	73	62	0.18	76	62	0.61	Closed
4/12/94	0.05	77	62	0.20	76	62.5	0.25	Closed
5/10/93	0.29	75	65	0.86	75	59	0.34	Closed
4/14/93	0.13	63	58	0.41	61	58	0.32	Closed
4/27/92	0.20	63	67	1.67	61	67	0.12	Closed*
4/14/92	0.73	61	64	2.14	62	63	0.34	Closed
4/08/92	0.42	74	64	1.36	77	64	0.31	Closed

* Gates opened on May 1, 1992

Recoveries at the SWP and CVP salvage facilities: Average flow at Freeport was relatively high (33,880 cfs) following the releases, and average combined CVP and SWP exports also were high (11,370 cfs). Although the percentages of the release recovered at the facilities were relatively low, fish released into the Sacramento River at Ryde were entrained at the federal salvage facility; evidence that even under high outflow, Sacramento River chinook can be diverted into the interior and south Delta via either three mile slough or around Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers when exports also are very high. This is similar to data from 1995, a year of extremely high outflow in which exports also were above 11,000 cfs, when high numbers of both Ryde and Georgiana Slough fish were salvaged.

As expected, more CWT salmon from the Georgiana Slough group (2.28%) showed up in salvage than from the Courtland release (1.55%), which in turn had more recoveries than from the Ryde release (0.04%)(Table 7). This indicates that some Courtland fish did use Georgiana Slough as a pathway (or came through Three Mile Slough or the West San Joaquin River) which further makes the higher survival index of the Courtland group appear anomalous. However, this can be explained by the fact that unlike the Ryde group, recoveries of the Courtland fish extended into mid February, after trawling effort at Chipps Island was reduced. This inflates the index because the smaller the percentage of time sampled, the smaller the denominator of the survival equation. This extended recovery period is consistent with that of the Georgiana Slough group, which also obviously traversed the interior Delta and therefore had a longer route to Chipps Island. This suggests that the Georgiana Slough index also is somewhat inflated, relative to the Ryde index.

Low survival of fall run chinook salmon smolts migrating via the central Delta relative to that in the mainstem Sacramento is well documented and has been attributed in part to increased residence time associated with the longer Delta migration route and thus increased exposure to predation and the adverse effects of high water temperature. Three years of late-fall run experiments are beginning to document with some consistency that increased Delta residence is harmful to late-fall run fish as well. Despite cooler water temperatures and the presumed size-related reduced vulnerability to predation, survival for juvenile late-fall (and presumably winter run smolts) migrating through the central Delta via Georgiana Slough (or the Delta Cross Channel when open) is less than for those migrating down the mainstem Sacramento River. This is supported in the ratios of the past three years, and this phenomenon may even be greater for late-fall run (and therefore winter run) than for fall run fish.

Fall run experiments: San Joaquin River Delta

Introduction

Escapement in the San Joaquin River tributaries has fluctuated dramatically for many years with peak escapement values near 70,000 fish, but from 1989 to 1995, total basin escapement has not exceeded 10,000 fish (Figure 7). Relationships exist between escapement and production, and spring time flow and CVP/SWP exports 2 ½ years earlier, when respective year class outmigration occurs (California Department of Fish and Game, 1987 and United States Fish and Wildlife Service, 1991). As flows increase and exports decrease, adult escapement and production increases. The most likely variable responsible for the adult relationships is smolt survival.

In general, results from various historical smolt survival experiments conducted in the South Delta indicate that: 1) survival to Chipps Island for coded wire tagged smolts has become increasingly low over the past 7 years and similarly recovery of the tagged smolts at the CVP and SWP fish facilities has markedly decreased, 2) survival through the San Joaquin Delta is much lower than that experienced in the Sacramento Delta, and 3) survival down the mainstem San Joaquin River is generally greater (by about two fold) than that for smolts emigrating down upper Old River. The latter finding suggests that a full barrier at the head of upper Old River during their migration could increase smolt survival and thus benefit the adult population.

Recent mark and recapture experiments have attempted to evaluate the use of a temporary barrier at the head of Old River as a means to increase smolt survival. However, in 1992, water temperatures increased significantly after barrier installation, preventing an unbiased evaluation. In 1993 and 1995, direct evaluations were not possible because high river flows prevented barrier installation. And in 1994, all survival indices were too low to infer a difference attributable to the barrier. These complications in experimental conditions have made benefits directly associated with barrier operation unquantifiable. Based on data from previous Dos Reis vs. upper Old River CWT experiments (United States Fish and Wildlife Service, 1990), it is reasonable to expect that the barrier at the head of Old River can benefit survival under certain flow, export, and temperature conditions.

Given this lack of successful direct testing of the barrier, the objective of the 1996 south Delta study was to obtain replicates (at two different water temperatures) of indices of survival through the San Joaquin Delta with a barrier in place, under at least a 4:1 ratio of Vernalis flow to total CVP/SWP export. The hypotheses is that at any one level of export, flow and temperature, the barrier will increase survival. This 1996 program is intended as the first in a five year series of annual studies designed to provide information on the benefits and impacts of the head of Upper Old River barrier to juvenile chinook survival.

Installation of a barrier at head of Old River can only be physically performed when San Joaquin River flows are below 5,000 cfs. High flows in the winter of 1996 caused uncertainty about whether the barrier at the head of upper Old River would be installed, so alternate study designs were developed for a barrier-in condition, a no-barrier condition, and a third condition in which a barrier would be in place for only part of the evaluation period. The preferred option was to have barrier construction completed by April 15, after which flows would be increased to the levels needed to provide a minimum 4:1 inflow/export ratio from April 15 through May 15. This is referred to as the "pulse flow" period, and was the period over which smolt survival was to be measured.

As in many past years, a barrier was not in place for a majority of the study. Installation was delayed until May 11 due to problems obtaining the required permits, then, five days later, levee concerns and flooding possibilities forced the barrier to be partially breached on May 16. Ongoing uncertainty about if and when the barrier might be reinstalled forced deviations in the alternate planned experimental design.

Methods

Ultimately, the core of the study consisted of making two sets of CWT fish releases in the San Joaquin River Delta during the pulse flow period. These core releases were made using fish from the Feather River Hatchery. The sites for the first set of releases were at Mossdale (upstream of the head of Old River), on the San Joaquin River just upstream of Turner Cut (hereafter referred to as Turner Cut) and at Jersey Point, on April 15, 17 and 18, respectively (Figure 29). Conditions at this time included river temperatures of 59.5 - 63° F, combined exports of approximately 1500 cfs, and San Joaquin River flows of approximately 7,000 cfs at Vernalis (Figure 30). The second set of releases were made at Mossdale, Dos Reis (downstream of the head of Old River), Turner Cut and Jersey Point on April 30, May 1, 2 and 3, respectively. Flow and export conditions remained similar but river temperatures were higher, at 63 - 70° F. To increase recovery numbers at Chipps Island and minimize the effects of sampling variation, and thus improve confidence in our survival indices, release size was increased from 50,000 to 100,000 fish at Mossdale and Dos Reis.

Additional releases were made at Dos Reis on May 9 and May 16 (50,000 fish each, because of limited fish availability) to index survival with the barrier at low exports and with the partial barrier at higher exports and flows. Following the pulse flow period, exports increased to about 3,000 cfs on May 16 and increased again on May 21 to 8,300 cfs. By May 26, combined exports had resumed to pre-pulse flow levels of greater than 10,000 cfs. Meanwhile, San Joaquin River flow ramped up to almost 12,000 cfs between May 16 and May 24, then tapered off again after May 26 (Figure 30). Although releasing these groups at Mossdale may have better represented survival of natural smolts moving through the Delta with the barrier (or partial barrier) in place, the barrier was yet under construction on May 9 and it was determined a cleaner estimate of survival to evaluate a barrier-in condition would be obtained by releasing the fish downstream of the barrier site, at Dos Reis. Similarly, the May 16 release also was made at Dos Reis, which also allows a cleaner direct comparison to the May 9 release group.

In addition to the recoveries made in the trawl at Chipps Island, fish were collected from salvage facilities associated with the SWP and CVP pumping plants in the south Delta.

Results

The first set of releases had survival indices of 0.02, 0.10 and 0.47 for Mossdale, Turner Cut and Jersey Point, respectively. As expected, survival improved as the fish were released closer to Chipps Island, but indices from both Mossdale and Turner Cut were low (Table 10).

The second set of releases had slightly lower survival indices of 0.01, 0.04 and 0.45 (Table 10). Although raw indices were slightly lower than for the first set, the trends between the releases within a set were similar. The index for the release at Dos Reis also was very low, at 0.02.

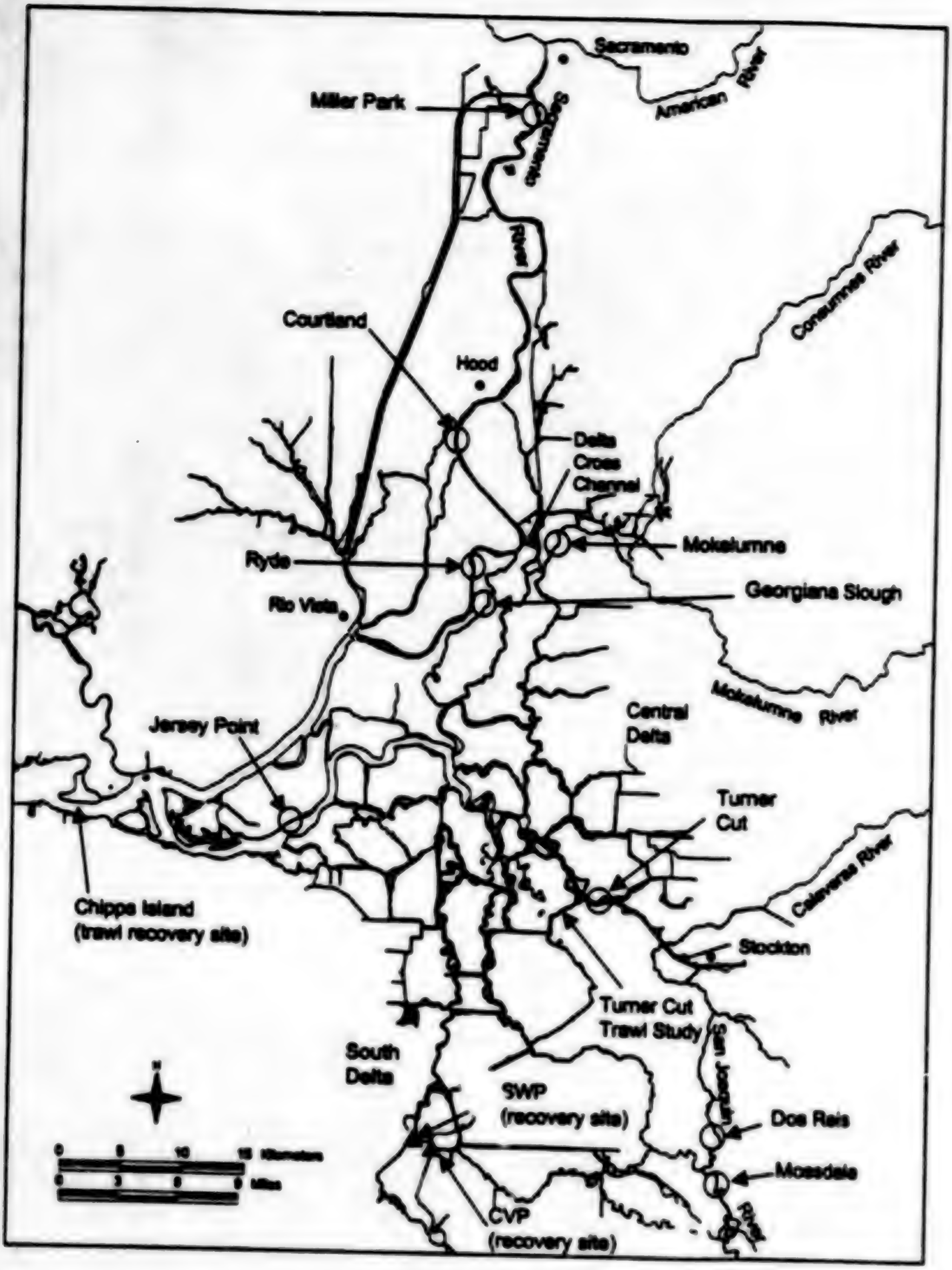


Figure 29. 1996 release sites and recovery locations for CWT fish in the Delta.

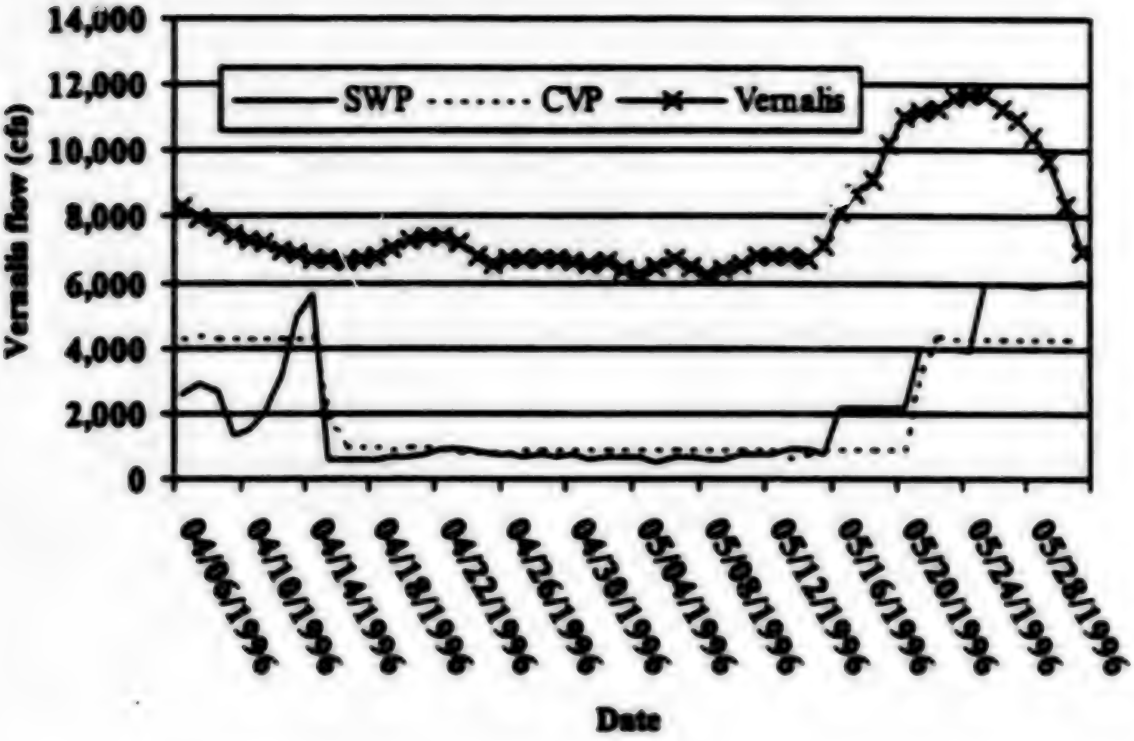


Figure 30. Flow at Vernalis and SWP and CVP export levels over the pulse flow period, Apr 15 - May 15, 1996.

There were no recoveries made at Chipps Island from the releases made at Dos Reis on May 9 or May 16 under the increased export condition (survival indices = 0.0), even though river temperatures remained fairly stable (Table 10).

Table 10: Survival indices and expanded SWP and CVP salvage numbers for releases made in the San Joaquin Delta in 1996. Also included are release numbers, average smolt size at release, truck and river temperatures at release, and total percent of release salvaged.

Release Date	Release Site	Number Released	Average Size of Fish (mm)	Truck Temp. (F)	River Temp. (F)	Survival Index	Expanded SWP salvage	Expanded CVP salvage	% of release salvaged
April 15	Mossdale	100,742	78	48.5	58.5	0.02	34	1058	1.08%
April 17	Turner Cut	50,103	79	52	63	0.10	0	12	0.02%
April 18	Jersey Pt	50,041	78	50	62	0.47	0	0	0%
April 30	Mossdale	98,898	81	61.5	64	0.01	106	1332	1.44%
May 1	Dos Reis	98,819	84	52	63	0.02	0	0	0%
May 2	Turner Cut	98,023	83	58, 62*	70	0.04	0	24	0.02%
May 3	Jersey Pt	50,020	87	50.5	64	0.46	0	12	0.02%
May 9	Dos Reis	30,168	83	54	60	0.00	8	0	0.02%
May 16	Dos Reis	50,243	88	61	62	0.00	38	12	0.10%

* fish hauled to release site in 2 separate trucks

Discussion

The recovery numbers at Chipps Island for the Mossdale releases were very low, as in previous recent years. This makes true differences in survival rates difficult to discern, given that at these low numbers, the influence of random sampling variation at Chipps Island can be very large. It is of note that the truck temperature for the second release was 61.5° F, which is higher than optimum to keep stress levels down during transport.

A significant survival decrease appeared to occur at Turner Cut from the first release to the second, where we also observed a corresponding large increase in river temperature from 63 to 70° F. It is unclear why river temperature was so high at this location, but it may have contributed to the lower survival rate.

Even with the controlled flow and low export conditions, the overall magnitude of the 1996 indices perpetuates the trend of very low survival in the San Joaquin Delta over the previous seven years.

Recoveries at the SWP and CVP salvage facilities: Expanded numbers of marked fish at the state (SWP) and federal (CVP) fish facilities were relatively low in 1996 (Table 10). As previously suggested, the larger numbers salvaged at the CVP from the Mossdale releases indicate that when there is no barrier at the head of Old River, many San Joaquin River smolts migrate via Old River, a route which exposes them first to the CVP facility. Also, exports at the CVP were somewhat higher than at the SWP immediately following the April 15 release (Figure 30). Percentages of release salvaged of Turner Cut and Jersey Point groups were very low, ranging from 0% to 0.02%. Percentage of release salvaged of Dos Reis fish ranged from 0% up to 0.1%, after the pulse flow period and after exports had been increased to 3000 cfs. These are very low percentages compared to those for some Dos Reis releases made in previous years such as 1987 (5.91%), 1989 (5.12%), and 1991 (6.92%). It appears that although in 1996 the 4:1 inflow to export ratio may not have greatly improved survival rates to Chipps Island, it may have helped reduce direct mortality of Dos Reis fish at the facilities, and probably similarly for fish released at Turner Cut. Note that salvage numbers are not direct loss values which must account for predation losses in Clifton Court Forebay, losses at the screens, as well as other losses.

Additional data from San Joaquin River tributary releases: Low survival in the south Delta in 1996 seems to be supported by the low recovery numbers at Chipps Island from CWT releases made by the Department of Fish and Game in the San Joaquin River tributaries using smolts from the Merced River Fish Facility (MRFF). Similar to the Delta indices, indices for releases made in the upper and lower Merced and Tuolumne Rivers also were extremely low (Table 11). As with the Mossdale releases, higher salvage numbers at the CVP indicates these fish are using Old River as a pathway, which exposes them to the CVP facility first.

Table 11: Survival indices, expanded SWP and CVP salvage numbers, and % combined salvage for releases made in the San Joaquin River tributaries in 1996. Also included are release numbers and average smolt size at release.

Release Date	Release Site	Number Released	Average Size of Fish (mm)	Survival Index	Expanded SWP salvage	Expanded CVP salvage	% of release salvaged (SWP+CVP)
April 25	Upper Merced	86,411	80	0.01	9	288	0.34%
April 26	Lower Merced	64,337	93	0.01	12	252	0.41%
April 26	Upper Tuolumne	67,446	88	0.04	54	384	0.65%
April 27	Lower Tuolumne	50,608	90	0.07	15	360	0.74%

Evidence that the low indices were not the result of poor trawl efficiency at Chipps Island comes from releases made with FRH smolts at Miller Park on the Sacramento River, on April 15 and May 6, where survival indices were 1.09 and 0.58, respectively. With the seemingly favorable flow and export conditions in 1996, it is unclear why South Delta and San Joaquin tributary survival was so low, but based on the consistency of the indices, it does not appear to be a spurious result.

Comparisons to 1995 Results: While water temperatures between 1995 and 1996 were similar, flows at Vernalis were much higher in 1995, ranging between 20,000 to 25,000 cfs, whereas they were in the 6,000 to 7,000 cfs range in 1996. Exports too were somewhat higher in 1995, but still there existed a 5:1 inflow to export ratio, versus the 4:1 ratio tested in 1996.

Survival indices for releases made at Mossdale and Dos Reis in 1995 with Feather River stock were higher than similar releases made in 1996. However, direct comparisons of the raw survival indices can be misleading because variables such as flow conditions may influence trawl efficiency at Chipps Island.

Relative comparisons, using the ratio of survival indices within a release pair in which the fish are recovered concurrently, provide a valid way to compare different releases over time. This method factors out any change in efficiency of the recovery gear, assuming that the efficiency of the gear is the same for both groups within the release pair. It also compensates for differences such as changes in water temperatures over time. Therefore, this comparison can be better made by looking at the survival ratios from Mossdale or Dos Reis to Jersey Point which are estimates of absolute survival between release sites (Table 12). We did not see the much higher estimates of absolute survival than we did in 1995, rather, survival was more similar to that seen in the early 1990's. Note, however, that the 1995 ratios were all calculated to a single denominator (Jersey Point, Index 0.46). If this Jersey Point index was artificially biased low it would raise all the absolute survival estimates for 1995.

Table 12: Survival ratios from Mossdale to Jersey Point and Dos Reis to Jersey Point, 1989 -1996.

Release Pair	Raw Survival Indices	Survival Ratio (absolute survival estimate)
1996 Apr 15 Mossdale:Jersey Pt	0.02 : 0.47	0.04
1996 Apr 30 Mossdale:Jersey Pt	0.01 : 0.35	0.03
1996 May 1 Dos Reis:Jersey Pt (FRH)	0.02 : 0.35	0.06
1996 May 1 Dos Reis:Jersey Pt (MRFF)	0.09 : 0.70	0.13
1995 Apr 17 Mossdale:Jersey Pt	0.22 : 0.46	0.48
1995 Apr 17 Dos Reis:Jersey Pt	0.15 : 0.46	0.33
1995 May 5 Mossdale:Jersey Pt	0.12 : 0.46	0.26
1995 May 5 Dos Reis:Jersey Pt	0.39 : 0.46	0.85
1995 May 17 Mossdale:Jersey Pt	0.07 : 0.46	0.15
1995 May 17 Dos Reis:Jersey Pt	0.16 : 0.46	0.35
1994 Mossdale:Jersey Pt	0.0 : 0.18	0.0
1994 Mossdale:Jersey Pt	0.04 : 0.28	0.14
1991 Dos Reis:Jersey Pt	0.16 : 1.70	0.09
1990 Dos Reis:Jersey Pt	0.04 : 0.61	0.07
1990 Dos Reis:Jersey Pt	0.04 : 1.04	0.04
1989 Dos Reis:Jersey Pt	0.14 : 0.88	0.16
1989 Dos Reis:Jersey Pt	0.15 : 0.97	0.15

The higher survival seen in 1995 between Mossdale and Chipps Island could be partially associated with the higher inflow/export ratio of 5:1 (vs. 4:1 in 1996) but more likely reflects the much higher San Joaquin River outflow in 1995. Effectively, the barrier was not in place for either year. However, comparison of groups released at Dos Reis with those at Mossdale in 1995 estimate a 30 to 44 percent increase in survival associated with the barrier, while such a comparison of 1996 data indicates a 50 percent benefit, again taking into consideration the low confidence provided by the very low indices in 1996. This observation assumes that survival of the Dos Reis release groups fairly represent survival of the Mossdale groups given a barrier in place at Old River. This may indicate that the benefits of a barrier can be greater in years of lower outflow.

Survival of San Joaquin tributary releases: Similar to the Delta releases, smolts released in the tributaries (Merced River stock) survived at higher levels in 1995 than in 1996 (Table 13). The fact that the 1996 indices for the upper and lower Merced releases were the same (0.01) would indicate that survival in the Merced was actually quite high (approaching 100%), and that the high mortality occurred downstream or in the Delta. It would appear survival in the Tuolumne was not as good as in the Merced in 1996, but when indices are this low, the influence of random sampling variation at Chipps Island can be very large, making true differences difficult to resolve. However, percent combined salvage also was much higher in 1995, indicating that many more fish may have at least made it to the Delta that year.

Table 13: Survival indices and % salvaged for releases made in the San Joaquin River and tributaries in 1995 and 1996.

Release Site	1995 Survival Indices	1996 Survival Indices	1995 % Salvaged (SWP+CVP)	1996 % Salvaged (SWP+CVP)
Upper Merced	0.15	0.01	1.7	0.4
Lower Merced	0.20	0.01	2.0	0.5
Upper Tuolumne	0.25	0.04	2.9	0.7
Lower Tuolumne	0.22	0.07	3.2	0.9

Much uncertainty has occurred in the last few years regarding the permitting, design, and installation of a temporary barrier at the head of upper Old River. If a standardized temporary barrier could be tested for several years without changes in design and uncertainty regarding installation, assessment of the benefits and impacts of a permanent barrier could be significantly improved. Releasing coded wire tag smolts at Mossdale, Dos Reis and Jersey Point over many years (with and without a barrier) at various export and flow levels, using smolts from Merced River Fish Facility, would be a systematic approach. Releases at Mossdale allow indices of survival through the entire San Joaquin Delta to be obtained. Additional releases at Dos Reis allow comparisons to be made with the Mossdale groups, to estimate absolute survival between Mossdale and Dos Reis and assess any loss associated with Upper Old River. If a complete barrier is present, the comparison between the Dos Reis and Mossdale groups will test the assumption that losses between Mossdale and Dos Reis are low. These releases in conjunction with one made at Jersey Point provide a way to estimate absolute survival between Mossdale and Jersey Point and Dos Reis and Jersey Point. Similarly, a release at Port Chicago allows absolute survival (between Jersey Point and Port Chicago) to be estimated for the Jersey Point groups, via recoveries in the ocean fishery.

Special Investigations

Several new components were added to the study in 1996, designed to assess if results of past experiments in the south Delta had been influenced by the use of out-of-basin fish (primarily from Feather River Hatchery), and to identify if release methods might be contributing to the poor survival observed in the south Delta in recent years.

Survival of Feather River Hatchery (FRH) vs. Merced River Fish Facility (MRFF) Stocks: In recent years, most CWT survival experiments in the San Joaquin (south) Delta have been conducted using smolts from the Feather River Hatchery, located on the Feather River, a tributary of the Sacramento River (Figure 29). It has been hypothesized there may be an inherent survival disadvantage for smolts released outside of their basin of origin such as a negative physiological response to the foreign waters, or confusion navigating out of the estuary. These factors may have biased previous results, and could explain the trend in recent years in which Sacramento Delta survival has been consistently higher than San Joaquin Delta survival.

In 1989, both stocks were released at Dos Reis and had very similar survival indicies. However, the releases were not made concurrently, with the MRFF group going out 12 days after the FRH group, into slightly higher river temperatures. Therefore, the recovery periods at Chipps Island also were not the same. Furthermore, the FRH fish averaged 15mm larger than the somewhat undersized MRFF fish (Appendix 2), thus this may not have been an appropriate measure of the difference between the two stocks.

Methods

In 1996, groups of distinctly coded fish from the MRFF were released coincidentally with the FRH fish at Dos Reis on May 1 and also at Jersey Point on May 3. Fish size was very similar for the two stocks released at Dos Reis, while at Jersey Point, the FRH stock was the larger of the two by ten millimeters, and Absolute survival from Dos Reis to Jersey Point was then estimated by comparing differential survival to Chipps Island for the Dos Reis and Jersey Point groups from each hatchery.

Results

Raw survival indices of the MRFF release groups were 4.5 times higher at Dos Reis and 1.5 times higher at Jersey Point than for the corresponding FRH groups (Table 14). More appropriately, absolute survival estimates from Dos Reis to Jersey Point was 0.04 for the FRH groups, and 0.13 for the MRFF groups. Although this is a threefold difference, it is not representative of the very large differences observed in recent years between Sacramento Delta and San Joaquin Delta survival, and therefore the use of FRH test fish in the south Delta probably does not by itself explain these interbasin survival differences, although it certainly may contribute to them. Still, this indicates it may be prudent to use smolts from the MRFF for future south Delta experiments, although production at this small facility has been and will likely continue to be a limited source for test fish. However, more dual stock release experiments should be conducted in future years to verify this result.

Table 14: Stock comparison releases at Dos Rais and Jersey Point. Average fish size, truck temperature and river temperature are included.

Release Date	Release Site	Hatchery of Origin	Average Size of Fish (mm)	Truck Temp (F)	River Temp (F)	Survival Index	Absolute survival Dos Rais:Jersey Pt (ratio)
May 1, 1998	Dos Rais	FRH	83.5	52	63	0.02	0.04 FRH
May 1, 1998	Dos Rais	MRFF	84	57	63	0.09	0.13 MRFF
May 3, 1998	Jersey Pt	FRH	87	50.5	64	0.45	
May 3, 1998	Jersey Pt	MRFF	77	50	65.5	0.72	

Short Term Mortality Evaluation (Net Pen Studies): There is speculation that recent low survival estimates in the south delta could in part be attributable to the stressors associated with loading, transporting and releasing CWT smolts. For example, as water must be kept cold during transport to minimize stress on the fish, these test fish typically experience temperature differences upon transfer from the colder water of the delivery truck to the warmer water of the river. These differences have been as great as 18°F, although typically they are less than 12°F. An on-site net pen study was conducted to determine if these transport and release stressors have a significant and immediate (or short term) impact on the survival of these fish.

Methods

At Dos Rais on May 1, during the regular CWT chinook release process, a subsample of approximately 200 fish from both the FRH group and the MRFF group were released directly into separate net pens. The MRFF release was delivered in two trucks, but the tag codes were mixed, so fish were taken from each truck and combined into a single pen. The remainder of the fish were released directly into the river as is normally done. The two pens were then moved a short distance upstream to avoid disturbances at the boat ramp, and submerged and anchored. A round the clock watch was posted to insure that the fish were not disturbed.

On May 3, after holding on site for 48 hours, the fish were inspected to assess general health, vigor and mortality. Additional observations were made on a subsample (n=30) from each pen. These observations included the following general health indicators (as suggested by Scott Foott of the California/Nevada Fish Health Center of the U.S. Fish and Wildlife Service):

1) eyes - bulging or swelling of the eyes (dorsal view)
2) color - anything diverting from the healthy condition of green with black spots on the dorsal and silvery sides
3) fin hemorrhaging - blood spots at the base of fins
4) scale loss - an estimation of the % scale loss, visible as darker splotches
5) gill color - the operculum was lifted and a value of 1 through 5 was assigned to the color of the gill, where;

1 = white or grey
2 = pink/light red
3 = cherry red
4 = dark cherry red
5 = beet red

Fish were anesthetized two at a time to minimize stress prior to making the above observations. The remainder of the fish in the pens were noted for their level of vigor and mortalities were counted as they were dipnetted out of the net pen and released.

In anticipation of higher river temperatures, the study was repeated for the FRH release at Dos Reis on May 16 to see if the results may be temperature related. The following was done differently:

1) A control group of 30 fish were worked up for the above parameters immediately after release.
2) To allow more precision in determination of when any gross mortality may occur, the fish were checked more frequently by briefly raising the net pen out of the water and making a note of fish activity (or lack thereof).
3) Water temperature was recorded several times each day.

On May 6, to obtain a post-Delta migration assessment on the first Dos Reis group, an attempt was made to perform a similar complement of observations on these fish when recovered in the trawl at Chipps Island.

Results

On May 1, the temperature of the river was measured at 63°F, and truck temperature of the Feather River Hatchery group was measured at 52°F, providing an 11°F difference to evaluate for that stock. Using the same thermometer as was used for the river, temperatures from the Merced trucks were measured at 59°F and 55°F, yielding between a 4° - 8°F temperature difference for the Merced fish. Measurements taken by hatchery truck drivers with personal thermometers gave conflicting data. The various temperatures recorded are listed in Table 15, but for this report the truck temperature taken with the same thermometer as was used for the river will be considered as the most reliable.

Table 15: Truck temperatures recorded with various thermometers at Dos Reis. The temperatures in bold were taken with the same thermometer, and considered for analysis in this report.

Release Date	River temp (F)	FRH Truck temp (F)	Diff. River-FRH	MRFF Truck 1 temp (F)	Diff. River-MRFF (truck 1)	MRFF Truck 2 temp (F)	Diff. River-MRFF (truck 2)
May 1	**63**	**52**	11	**59** 53 56 51.5	4	**55** 53	8
May 16	62	51	11	no release		no release	

Forty-eight hours after the May 1 release, Feather River fish were all vigorously active. Eyes were normal, with the exception of one fish which had one enlarged eye. Color contrasts appeared to be distinct (normal) and no fin hemorrhaging was observed. Scale loss ranged from less than 2% to 10% on one individual. Gill color was subjective, but in general all fish gills looked healthy and were assigned a score of 3 (18 fish) or 4 (12 fish). All plus counted fish (n=160) were observed to be vigorously active when netted out of the pen and released.

The Merced River stock was similarly vigorously active. Eyes on all fish were normal, and color contrast was distinct (normal), with the exception of one individual who had an obvious traumatic injury on one side. This fish had high scale loss associated with the injury and a faded red color to the gills which was assigned a 2 value. All other fish were observed to have a scale loss ranging from insignificant to 10% on one individual, and a score of 3 (18 fish) or 4 (11 fish) was assigned to gill color. All plus counted fish (n=176) were observed to be vigorously active when netted out of the pen and released.

By May 16, river temperatures remained stable, and provided another 11°F temperature difference to evaluate. The control group worked up immediately after the release had normal eyes, and no signs of fin hemorrhaging. All had distinct contrasts in coloration, except one individual which had faded dorsal pigmentation. Scale loss seemed somewhat higher than for the May 1 groups and ranged between 2% and 15%. Gill color was dark red and was assigned a 4 for all fish in the subsample. All fish were vigorously active prior to being anesthetized. Because of the additional handling, these control fish were not held for the 48 hour evaluation.

Temperatures ranged between 60.5 and 62 degrees over the 48 hour holding period. No mortalities were observed during the periodic checks on the fish.

After 48 hours, observations were again made on a subsample of the held fish (n=30). All had normal eyes, distinct color contrasts, and no signs of fin hemorrhaging. Scale loss was observed to be much higher in this group, however, and was estimated to range from 2% to 30%. There may have been some additional scale loss associated with the daily checking of the fish for mortalities. Gill color was assigned a score of 3 (18 fish) or 4 (12 fish). All fish were vigorously active prior to being anesthetized. All remaining fish in the pen (n=162) were observed to be vigorously active when released.

Discussion

Although the FRH group experienced a greater water temperature change when they were released (11°F) than did the MRFF counterpart (4 to 8°F) (Table 15), this did not appear to effect the condition nor increase the mortality rate of the fish that were held for observation. The single observed mortality (MRFF group) after the 48 hour holding period had sustained a severe and apparently lethal handling injury. It appears that "temperature shock" of this magnitude and at these temperatures did not adversely affect the condition of these test fish, at least not within two days after release. It is possible that after release, fish not protected within a net pen may be more vulnerable to predation for a period of time than those which have adapted fully to the surroundings, as a result of disorientation from the release process and/or temperature shock. However, in 1996, the largest temperature differential experienced by any release group was 15.5° (MRFF stock, Jersey Point), yet this group survived reasonably well at 0.72.

Physiological Evaluation: The general health indicators observed in the net pen evaluation study were only intended to detect gross effects of disease and stress. To get more substantial data on the health and condition of these fish, physiological analyses were performed on an additional subset of fish from each hatchery released at Dos Reis on May 1, by fish pathologist staff from the California/Nevada Fish Health Center near Anderson.

Methods

Only a general summary of methods and results are presented here. A detailed report is provided by True, 1996. Fish from both MRFF and FRH were examined for internal parasites, bacterium infections, triglyceride levels and stress glucose response. Organosomatic analyses and ATPase assays were also performed. A set of 12 fish from each facility were also assessed for osmoregulatory ability.

Results

Both stocks were overall healthy, and no significant differences were detected that may have affected in-Delta survival. While the parasite responsible for Proliferative Kidney Disease (PKX) was detected in the Merced River stock in an early infection stage, it should not have affected short term (ie. through Delta) survival of this group. It should be noted however, that the development of this pathogen is progressive and may be a factor in adult survival of this stock (True, 1996).

No recaptures of the Dos Reis fish from either stock were made at Chipps Island on May 6, so post-outmigration health analyses was not possible.

Discussion

An explanation for the observed survival differences between FRH and MRFF stocks was not apparent in the physiological health examination. Still, to provide important information on the health and condition of the test smolts, it is recommended that these studies be continued, and potentially expanded to other key release sites as well, such as Jersey Point.

Turner Cut Diversion Rate: Delta hydrology changes when the barrier is placed at the head of Old River. For example, for a given export, the volume of water moving from the San Joaquin River into Turner Cut can increase, versus that diverted under a no barrier condition. It may then be hypothesized that under this condition the number of smolts diverted into Turner Cut also may be increased, which, like Old River, puts them on a path towards the pumping plants. This effect could somewhat counteract, to some degree, the benefits of the upper Old River barrier to outmigrating San Joaquin basin smolts. The net benefit of the barrier to San Joaquin smolts in any given year may be better estimated if the percentage of smolts diverted into Turner Cut can be correlated to the flow split at that junction, which can already be determined (Rick Oltmann, personal communication). A pilot study was attempted in 1996 to estimate the percentage of smolts diverted from the mainstem San Joaquin River into Turner Cut.

Methods

This study utilized the 50,000 CWT release group made on the San Joaquin River upstream of Turner Cut on April 17 as test fish to estimate percent diverted into Turner Cut. An intensive Kodiak trawling recovery effort was subsequently conducted in Turner Cut. To allow an expansion of recovered fish to percent diverted, trawl efficiency was needed. To get this estimate, known numbers of spray dyed fish were released into Turner Cut near the confluence with the San Joaquin River. This was done at the beginning of the flood tide, during which DWR hydraulic models have determined that flows enter Turner Cut from the San Joaquin River. Conversely, flow moves out of Turner Cut into the San Joaquin River on ebb tides. The release timing was intended to allow maximum recovery time prior to the tidal shift.

Results

This study met with logistical problems and did not produce the desired results. The main problem was that an estimate of trawl efficiency could not be obtained due to the prolonged length of time it took the test fish to pass the trawl site. There is a strong tidal influence at Turner Cut, such that while recovery of test fish was still occurring, there was a reversal in direction of flow in Turner Cut with the change in tide, and presumably, a reversal in the direction of fish movement. This may indicate that for any given smolt moving down the San Joaquin River and diverted into Turner Cut, there may be significant tidal sloshing back and forth, over which time a fish may come back to the San Joaquin River or continue down Turner Cut, depending on the relative magnitudes of outflow, exports and tides.

Fall run experiments: Sacramento River Delta

In 1996, a multi-year study was begun to provide a baseline estimate of survival on the lower Sacramento River. Coded wire tagged chinook releases at Sacramento have been performed historically, but without interannual consistency.

The objectives of the experiment were as follows:

1) Compare Delta survival under the environmental conditions specified in the CALFED Bay Delta Accord agreement of 1994 to results of similar studies conducted in previous years during pre-accord conditions (Water Quality Control Plan, 1995).

2) Obtain baseline smolt survival indices for the Delta (Sacramento to Chipps Island). This estimation of Sacramento Delta survival may be important in the future to assess the value/impact of specific actions taken in the northern Delta to improve conditions for fisheries.

3) Assess potential impacts of the head of Old River barrier on Sacramento River origin chinook by comparing recoveries of these fish at the fish salvage facilities to those recovered in experiments conducted in non-barrier years.

4) Obtain data for improving chinook smolt survival models for the Delta. This results of this work are reported separately and will not be discussed here.

Unfortunately, salvage numbers were insufficient for analysis as recovery numbers were very low during years when the Head of Old River Barrier was placed and this study was not completed.

Methods

A series of CWT releases (n = 50,000) were made on the Sacramento River at Miller Park (river mile 57), on April 25 and May 6, to index survival over the typical outmigration season of Sacramento River fall run smolts. In addition to 7 day per week trawling at Chipps Island, recoveries of these fish would be monitored in salvage at the CVP and SWP fish facilities.

The Delta Cross Channel gates were closed for the entire CWT recovery period (opened on June 12), and combined CVP/SWP exports were moderate (6,000 cfs).

Results

The survival index of the first group was 1.11, the highest we have obtained for a Miller Park release since we began using this release site in 1988 (Table 13). In fact, this is the highest index measured for any Sacramento release since 1982. The index for the second release was roughly half as high as the first, at 0.58. This could be attributable to the lower average flow at Sacramento (~28,200 vs. ~20,000 cfs) and higher river temperature (57 vs. 65° F) for the first release.

Discussion

The May 6, 1996 index is very similar to the single Miller Park index obtained in 1995 (0.63). This is the case even though Sacramento River flows were much higher (~73,000 cfs) and the river temperature was much lower for the 1995 experiment. As discussed in previous editions of this report, it is possible that trawl efficiencies can change significantly under different outflow conditions. Under the extremely high outflow conditions that we had in the spring of 1995, the efficiency of the trawl at Chipps Island may have been reduced, which could result in a lower survival index. Ocean recoveries in future years will not have such biases associated with gear efficiency, and should provide an independent means of verification of the Chipps Island indices (Brandes and McLain, 2000).

Other Miller Park releases in the 1990's have yielded indices ranging from 0.0 (no recoveries at Chipps Island) in 1994, to the 1996 value of 1.11 (Table 16). Both 1996 Miller Park indices were indeed much improved over those in 1994, a critical water year in which survival also was measured to be very low elsewhere in the Delta. Conditions were much poorer in 1994, with average Sacramento River flows under 10,000 cfs, and higher river temperatures (67 and 71° F). Furthermore, these high river temperatures combined with cool truck water during transport resulted in some of the more extreme temperature differences experienced by the test fish we have recorded (+15° F and +22° F). There appears to be a strong relationship between the temperature gap and the resulting survival index. When the temperature gap is 12° F or greater survival is typically low, at 0.35 or less, with one exception in 1990 when it was quite good at 0.85. Conversely, when the temperature gap is 9° F or less, survival is typically much better, at 0.43 or higher (Table 16). Studies are needed to assess the effects of such temperature differences on the short term mortality of these test fish. A good relationship exists between river temperature and survival already, hence, the temperature gap relationship with survival may simply reflect this.

Table 16: Historical releases at Miller Park (Sacramento) 1988-1996, water year type, truck water and river temperature at release, temperature difference and survival index.

release date	water year type	truck temp (F)	river temp (F)	temp. difference	survival index
May 5, 1988	critical	54	62	+8	0.65
June 23, 1988	critical	55	74	+19	0.08
June 1, 1989	dry	51	67	+16	0.16
June 14, 1989	dry	58	70	+12	0.20
May 7, 1990	critical	56	70	+14	0.85
Apr 25, 1991	critical	54	62	+8	0.78
Apr 29, 1991	critical	59	62	+3	0.49
Apr 23, 1993	above normal	53	61	+8	0.63
May 3, 1993	above normal	56	62	+6	0.43
May 21, 1993	above normal	51	65	+14	0.35
May 28, 1993	above normal	55	64	+9	0.75
May 3, 1994	critical	52	67	+15	0.07
May 24, 1994	critical	49	71	+22	0.00
May 1, 1995	wet	59.5	58.5	-1	0.63
Apr 25, 1996	wet	48	57	+9	1.11
May 8, 1996	wet	58	65	+7	0.58

Upper Sacramento River Releases:

Approximately 270,000 CWT fish from Coleman National Fish Hatchery were released into Battle Creek in the upper Sacramento River basin on April 23. The survival index of this group to Chipps Island was 0.44 (Table 17). This is very comparable to the index for a similar release made on April 24, 1995, also a wet year, which had an index of 0.38. Battle Creek releases in March 1996 had somewhat lower indices at 0.21 and 0.28, but the fish were considerably smaller. Also, trawling effort at Chipps Island was significantly less than 7 days/week in March, thus these indices are subject to higher variability. Water temperatures were not available for these releases, but are assumed to not have been warm enough to be detrimental to survival.

Table 17: Historical releases at Battle Creek, 1986-1996, water year type, number of fish released, average fork length and survival index to Chipps Island.

release date	water year type	number released	average fork length (mm)	survival index
May 13, 1986	wet	53,562	86	0.52
May 12, 1987	critical	51,708	84	0.18
May 9, 1988	critical	51,923	84	0.41
May 8, 1989	dry	51,074	69	0.26
May 11, 1990	critical	51,089	80	0.17
Apr 30, 1991	critical	64,373	78	0.21
Apr 14, 1992	critical	157,828	75*	0.12
Apr 13, 1993	above normal	58,076	72	0.73
Apr 28, 1993	above normal	183,957	72*	0.68
Apr 14, 1994	critical	180,805	70*	0.13
Apr 24, 1995	wet	152,187	73*	0.38
Mar 14, 1996	wet	295,384	65	0.24
Mar 29, 1996	wet	308,443	68	0.30
Apr 23, 1996	wet	268,980	80	0.44

* Average length of three different combined tagged groups

Other CWT Releases: A CWT release was made May 7 at Benicia, downstream of the Chipps Island trawl location, to serve as a control for many of the previously described delta experiments. Recoveries will be made in the ocean fishery in future years which will allow for an independent verification of the results of these experiments (Brandes and McLain, 2000).

Other agencies and entities released CWT salmon in the spring of 1996. These included releases in the Mokelumne River and the Feather River at Yuba City. See Appendix 1 for indices of survival to Chipps Island, calculated using our trawl recovery information.

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Personal Communications

Colleen Harvey, California Department of Fish and Game, Red Bluff, Ca.

Rick Oltman, U.S. Geological Service. Sacramento, Ca.

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Appendix 1. Calculated efficiency rates for CWT smolts released throughout the Central Valley and recovered by trawl at Chipps Island between 1980 and 1993. Trawl efficiency (the number caught by the midwater trawl divided by the number available for capture) is calculated by estimating the number surviving to Chipps (using the ocean index of survival) corrected by the time sampled).

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
1985													
6-1-14-5-2	Ryde	11-May-85	81	51,587	647	0.0125							
6-1-1-12-6 to 8	Battle Creek	24-Apr-85	73	152,157	1,166	0.0077	0.611999	92,999	0.1313	12,209	58	0.0048	
6-1-6-1-4 to 7	Feather River H.	03-Apr-85	49	196,984	1,466	0.0074	0.588729	116,352	0.1216	14,148	68	0.0048	
6-1-14-5-3	Miller Park	01-May-85	91	50,202	737	0.0147	1.168082	Unusually high recovery rate - not used in calculation					
6-2-11 & 12	New Hope L.	16-Apr-85	80	97,876	705	0.0072	0.574425	56,222	0.1343	7,551	51	0.0068	
6-2-13 & 14	New Hope L.	25-Apr-85	83	99,482	625	0.0063	0.501121	49,843	0.1389	6,923	49	0.0071	
6-2-10	Thornton	15-Jun-85	86	51,757	211	0.0041	0.325112	16,827	0.1389	2,337	18	0.0077	
6-1-14-5-1 6-1-14-6-14	Mossdale	14-Apr-85	79	100,989	407	0.0040	0.321400	32,457	0.1344	4,362	23	0.0053	
6-1-14-6-12	Dos Reis	17-Apr-85	79	50,848	209	0.0041	0.323083	16,428	0.1331	2,187	8	0.0037	
6-1-14-6-13	Jersey Point	18-Apr-85	78	50,789	249	0.0049	0.389329	19,778	0.1381	2,731	25	0.0092	
6-31-90 & 91	Mossdale	05-May-85	79	102,562	340	0.0033	0.264379	27,114	0.1331	3,609	13	0.0036	
6-31-47	Dos Reis	06-May-85	78	52,087	354	0.0068	0.541999	28,231	0.1343	3,791	21	0.0055	
6-1-14-8-4 6-31-49	Mossdale	17-May-85	79	104,125	330	0.0032	0.012530	1,300	0.1389	181	8	0.0442	
6-31-48	Dos Reis	17-May-85	77	51,888	221	0.0043	0.341127	17,824	0.1389	2,443	9	0.0037	
6-1-11-4-1 to 4	U. Merced	03-May-85	84	111,269	656	0.0059	0.469588	52,235	0.1354	7,073	18	0.0025	
6-1-11-4-5 to 7	L. Merced	04-May-85	82	63,016	213	0.0034	0.269015	16,969	0.1389	2,357	16	0.0068	
6-1-11-5-11 to 13	U. Tuolumne	04-May-85	88	83,536	942	0.0113	0.899253	75,123	0.1311	9,849	21	0.0021	
6-1-11-5-14 & 15	L. Tuolumne	06-May-85	88	53,536	583	0.0109	0.866387	46,483	0.1319	6,132	12	0.0020	0.0075

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
1994													
6-31-44	Benicia	10-May-94		54,257	1,167	0.0211							
6-1-16-4-1	Ryde	12-Apr-94	76	81,016	378	0.0073	0.343400	17,790	0.1389	2,472	11	0.0044	
6-26-27 to 29	Battle Creek	14-Apr-94	79	160,096	786	0.0049	0.234035	37,834	0.1382	5,227	22	0.0042	
6-1-6-1-1	Feather River	16-Mar-94	81	163,556	186	0.0018	0.055395	8,947	0.1362	1,219	6	0.0049	
6-1-14-4-2	Georgiana Sl.	12-Apr-94	77	51,466	214	0.0042	0.198794	10,130	0.1389	1,407	3	0.0021	
6-1-14-4-3	Jersey Point	13-Apr-94	72	50,555	421	0.0083	0.393176	19,829	0.1389	2,760	10	0.0036	
6-1-14-4-5	Ryde	25-Apr-94	75	58,130	683	0.0118	0.540094	31,385	0.1389	4,359	11	0.0025	
6-1-14-4-7	Georgiana Sl.	25-Apr-94	73	50,235	151	0.0030	0.142293	7,148	0.1389	993	5	0.0050	
6-1-14-4-8	Jersey Point	27-Apr-94	78	53,819	748	0.0139	0.658030	35,400	0.1389	4,918	16	0.0033	
6-1-6-1-2	Feather River	02-May-94	81	100,277	182	P 0018	0.048104	4,829	0.1389	671	1	0.0015	
6-31-42	Miller Park	03-May-94	83	53,252	323	0.0061	0.187421	10,689	0.1389	1,485	4	0.0027	
6-1-14-4-4	Mossdale	25-Apr-94	77	50,729	87	0.0017	0.081190	4,118	0.1389	572	2	0.0035	
6-31-43	Mossdale	06-May-94	80	53,880	31	0.0006	0.027236	1,467	0.1389	204	1	0.0049	
6-48-1 & 2	New Hope L.	23-May-94	90	102,732	742	0.0072	0.341889	35,125	0.1389	4,879	19	0.0039	
6-49-3 & 4	New Hope L.	16-May-94	90	103,479	394	0.0038	0.138002	14,281	0.1291	1,850	11	0.0059	
6-1-11-2-10 to 13	Merced R.	22-Apr-94	90	99,585	336	0.0034	0.160702	16,000	0.1389	2,222	6	0.0027	
6-1-11-2-14 & 15 6-1-11-3-1	Lower Merced	22-Apr-94	87	82,991	232	0.0028	0.133794	10,092	0.1389	1,325	2	0.0015	
6-1-11-3-2 to 4	U. Tuolumne	23-Apr-94	85	83,414	252	0.0030	0.143013	11,929	0.1389	1,657	3	0.0018	
6-1-11-3-5 & 6	L. Tuolumne	24-Apr-94	92	50,004	152	0.0030	0.1438	7,195	0.1389	999	2	0.0020	0.0034
1993													
6-31-37	Ryde	10-May-93	75	49,690	1118	0.0225							
6-1-14-3-6	Benicia (split)	7&15-Apr-93	80	53,080	434	0.0082		Ryde used as control instead of Port Chicago or Benicia					
6-1-14-3-7	Benicia	15-Apr-93	83	49,334	530	0.0107		Ryde used as control instead of Port Chicago or Benicia					
6-1-14-11-1 & 2	Battle Creek	13-Apr-93	72	90,341	1089	0.0121	0.540137	48,794	0.1348	6,573	45	0.0068	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-1-14-3-10	Georgiana Sl.	14-Apr-93	63	53,857	204	0.0038	0.168683	9,085	0.1345	1,222	7	0.0057	
6-1-14-3-8	Ryde	14-Apr-93	61	53,265	523	0.0098	0.437263	23,291	0.1365	3,179	23	0.0072	
6-1-14-3-11	Miller Park	23-Apr-93	68	54,454	784	0.0144	0.624809	34,023	0.1361	4,631	36	0.0078	
6-1-14-11-3	Rio Vista	26-Apr-93	69	28,056	326	0.0116	0.517458	14,518	0.1299	1,886	19	0.0101	
6-1-1-8-3 to 5	Battle Creek	26-Apr-93	72	183,957	3,441	0.0187	0.833013	153,239	0.1349	20,672	130	0.0063	
6-1-14-3-13	Miller Park	03-May-93	71	51,574	687	0.0133	0.593211	30,594	0.1334	4,081	23	0.0056	
6-31-36	Georgiana Sl.	10-May-93	75	51,560	350	0.0068	0.302300	15,587	0.1327	2,068	15	0.0073	
6-1-14-3-6	Mossdale	08-Apr-93	58	50,016	37	0.0007	0.032944	1,648	0.1360	224	2	0.0089	
6-1-14-3-12	Mossdale	26-Apr-93	71	55,742	92	0.0017	0.073500	4,097	0.1389	569	4	0.0070	
6-31-35	Mossdale	04-May-93	72	51,937	111	0.0021	0.095178	4,943	0.1389	687	4	0.0058	
6-31-38	Mossdale	12-May-93	75	52,616	89	0.0017	0.075328	3,963	0.1389	551	4	[illegible]	
6-63-41 & 42	New Hope Land.	06-May-93	78	100,443	600	0.0060	0.266020	26,720	0.1327	3,546	15	0.0042	
6-63-43 & 44	New Hope Land.	20-May-93	87	99,262	779	0.0078	0.349483	34,691	0.1186	4,114	10	0.0024	
6-31-39	Miller Park	21-May-93	80	49,786	558	0.0112	0.500021	24,894	0.1329	3,308	18	0.0054	
6-31-40	Miller Park	26-May-93	82	50,116	1,179	0.0235	1.047881	50,116	0.1386	6,946	40	0.0058	0.0065
1992													
5-29-30	Benicia	28-Apr-92	80	54,055	859	0.0159							
5-29-12 to 14	Battle Creek	14-Apr-92	71	157,828	98	0.0006	0.039074	6,167	0.1368	844	21	0.0249	
5-29-18	RBDD	15-Apr-92	71	49,373	35	0.0007	0.044609	2,202	0.137	302	18	0.0597	
5-29-19	Princeton	17-Apr-92	73	53,332	154	0.0029	0.181706	9,691	0.1389	1,346	24	0.0178	
6-1-14-2-11	Ryde	08-Apr-92	77	53,630	360	0.0067	0.422413	22,654	0.1389	3,147	78	0.0248	
6-1-14-2-10	Georgiana Sl.	08-Apr-92	74	51,848	144	0.0028	0.174779	9,062	0.1389	1,258	23	0.0183	
6-1-14-3-1	Ryde	14-Apr-92	62	42,534	498	0.0117	0.736777	31,338	0.1389	4,353	97	0.0223	
6-1-14-3-2	Georgiana Sl.	14-Apr-92	81	52,374	240	0.0046	0.288362	15,103	0.1385	2,092	41	0.0196	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-31-29	Ryde	27-Apr-92	81	53,099	218	0.0041	0.258353	13,718	0.1364	1,871	93	0.0497	
6-31-30	Georgiana Sl.	27-Apr-92	83	51,914	34	0.0007	0.041213	2,140	0.1347	288	11	0.0382	
6-1-14-2-12 & 13	Mossdale	07-Apr-92	78	107,103	75	0.0007	0.044088	4,720	0.1389	656	20	0.0305	
6-1-14-2-14 & 15	Mossdale	13-Apr-92	82	103,712	20	0.0002	0.012135	1,259	0.1389	175	13	0.0744	
6-1-14-3-3 & 4	Mossdale	24-Apr-92	84	104,739	44	0.0004	0.026435	2,769	0.1364	378	8	0.0212	
6-31-33 & 34	Mossdale	12-May-92	98	106,386	9	0.0001	0.005374	566	0.1362	77	2	0.0259	0.0329
1991													
5-1-1-1-4	Benicia	13-May-91	88	43,750	742	0.0170							
5-1-1-1-13	Battle Creek	30-Apr-91	78	64,373	273	0.0042	0.246227	15,850	0.1368	2,168	14	0.0065	
5-1-1-1-12	RBDD	01-May-91	77	64,118	375	0.0058	0.338449	21,701	0.1368	2,969	24	0.0081	
5-19-46, 47 &48	Princeton	03-May-91	80	51,979	173	0.0033	0.179298	9,320	0.1356	1,264	24	0.0190	
6-1-14-2-7&8	Miller Park	25-Apr-91	82	102,664	629	0.0061	0.353179	36,259	0.1389	5,036	85	0.0169	
6-1-14-2-9 6-31-24	Miller Park	29-Apr-91	80	104,516	465	0.0044	0.264831	27,680	0.1371	3,797	55	0.0145	
6-1-14-2-6	Jersey Point	19-Apr-91	82	52,139	358	0.0069	0.404850	21,108	0.1375	2,902	94	0.0324	
6-1-14-2-3 & 4	Empire Tract	17-Apr-91	78	95,602	156	0.0016	0.096213	9,198	0.1370	1,260	54	0.0429	
6-1-14-1-14 & 15	Dos Reis	15-Apr-91	80	102,999	88	0.0009	0.050376	5,189	0.1374	713	17	0.0238	
6-1-14-2-1&2	Buckley Cove	18-Apr-91	79	99,341	118	0.0012	0.053830	5,348	0.1368	732	26	0.0355	
6-31-25 & 26	Buckley Cove	09-May-91	88	99,620	105	0.0011	0.062022	6,181	0.1368	847	20	0.0236	
6-31-28	Jersey Point	13-May-91	87	49,184	275	0.0056	0.344386	16,939	0.1389	2,353	89	0.0378	
6-31-27	L. Mokelumne R.	09-May-91	84	45,706	229	0.0050	0.269394	12,313	0.1378	1,697	31	0.0183	
6-1-14-2-5	L. Mokelumne R.	18-Apr-91	79	47,289	143	0.0030	0.178289	8,432	0.1389	1,171	79	0.0675	0.02987
1990													
5-20-60	Benicia	23-May-90	84	52,448	243	0.0046							
5-20-55	Battle Creek	11-May-90	83	51,068	39	0.0008	0.164821	8,417	0.1073	903	7	0.0078	
5-20-56	Red Bluff	12-May-90	82	51,533	33	0.0006	0.138208	7,122	0.0982	700	3	0.0043	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
5-20-57	Princeton	14-May-90	84	52,077	12	0.0002	0.049733	2,590	0.1389	360	5	0.0139	
6-31-18	Miller Park	07-May-90	74	48,390	115	0.0024	0.512918	24,820	0.1351	3,353	43	0.0128	
6-31-20	Ryde	09-May-90	79	51,878	173	0.0033	0.719729	37,338	0.1347	5,030	87	0.0173	
6-31-21	Steamboat Sl.	30-May-90	86	52,010	318	0.0061		Unusually high recovery rate - not used in calculation					
6-31-23	Sutter Slough	29-May-90	83	49,324	221	0.0045	0.967030	47,698	0.1389	5,530	38	0.0069	
6-31-22	Ryde	31-May-90	84	50,837	218	0.0043	0.925513	47,050	0.1375	6,469	67	0.0104	
6-1-14-1-10&11	Dos Reis	02-May-90	74	103,533	34	0.0003	0.070877	7,338	0.1389	1,019	4	0.0039	
6-1-14-1-12&13	U. Old River	03-May-90	77	103,595	11	0.0001	0.022917	2,374	0.1389	330	1	0.0030	
6-31-19	Jersey Point	04-May-90	77	50,143	208	0.0041	0.895280	44,892	0.1271	5,705	56	0.0098	
6-1-11-1-14&15 6-1-11-2-1&2	U. Tuolumne	30-Apr-90	83	93,663	18	0.0002	0.041482	3,885	0.1343	522	4	0.0077	
6-1-14-1-5 & 6	U. Old River	17-Apr-90	72	106,267	14	0.0001	0.028434	3,022	0.1163	351	2	0.0057	
6-1-14-1-9	Jersey Point	18-Apr-90	71	52,982	224	0.0042	0.912030	48,345	0.1296	6,266	32	0.0051	
6-1-14-1-7 & 8	Dos Reis	16-Apr-90	72	105,742	23	0.0002	0.046845	4,984	0.1285	638	4	0.0063	
6-1-11-2-3 to 5	L. Tuolumne	01-May-90	72	80,236	18	0.0002	0.048419	3,885	0.1389	540	1	0.0019	0.00772
1989													
6-1-14-1-4	Port Chicago	19-Jun-89	92	48,329	352	0.0073							
5-20-37	Battle Creek	08-May-89	68	51,074	83	0.0016	0.223122	11,396	0.1261	1,438	13	0.0090	
5-20-38	RBDD	09-May-89	70	52,677	82	0.0017	0.239790	12,631	0.1267	1,600	18	0.0112	
5-20-39	Princeton	10-May-89	72	50,842	80	0.0016	0.243044	12,357	0.1124	1,389	27	0.0194	
6-31-11	Courtland	02-May-89	67	51,211	248	0.0048	0.659534	33,775	0.1383	4,671	46	0.0098	
6-31-12	Ryde	03-May-89	86	51,046	417	0.0082	1.121604	Unusually high recovery rate - not used in calculation					
6-31-10	Miller Park	01-Jun-89	80	52,612	80	0.0015	0.208771	10,984	0.1389	1,526	9	0.0059	
6-31-8	Courtland	02-Jun-89	92	50,659	41	0.0008	0.111120	5,629	0.1389	782	19	0.0243	
6-31-7	Ryde	02-Jun-89	88	50,601	82	0.0016	0.222485	11,258	0.1389	1,564	26	0.0166	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival in Chipps	# surviving in Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-31-15&17	Miller Park	14-Jun-89	89	94,804	68	0.0007	0.098888	9,338	0.1235	1,153	20	0.0174	
6-1-14-1-3 6-58-5	Courtland	15-Jun-89	91	90,720	84	0.0009	0.127128	11,533	0.1389	1,602	21	0.0131	
6-1-14-1-1	Steamboat Sl.	13-Jun-89	88	51,237	71	0.0014	0.190257	9,748	0.1389	1,354	50	0.0369	
6-31-18	Sutter Slough	13-Jun-89	90	49,782	151	0.0030	0.416824	20,732	0.1331	2,759	57	0.0207	
6-1-14-1-2	Ryde	16-Jun-89	89	51,134	10	0.0002	0.026851	1,373	0.1285	176	8	0.0454	
6-31-14	Dos Reis	20-Apr-89	85	52,982	34	0.0006	0.088141	4,668	0.1389	648	8	0.0123	
6-31-13	U. Old River	21-Apr-89	81	51,972	38	0.0007	0.100387	5,217	0.1389	725	5	0.0069	
6-1-11-1-11&12	Jersey Point	24-Jun-89	70	56,816	180	0.0032	0.434978	24,714	0.1385	3,422	53	0.0155	
6-1-11-1-7&9&13	Dos Reis	02-May-89	78	76,073	78	0.0010	0.140776	10,709	0.1265	1,355	11	0.0081	
6-1-11-1-4 to 6	U. Old River	03-May-89	70	74,341	16	0.0002	0.029550	2,197	0.1380	303	4	0.0132	
B6-14-8&10	U. Stanislaus	20-Apr-89	78	103,951	33	0.0003	0.043586	4,531	0.1385	628	7	0.0112	
B6-1-1 B6-14-11	L. Stanislaus	19-Apr-89	76	74,220	58	0.0008	0.109143	8,101	0.1389	1,125	17	0.0151	0.01843
1988													
6-31-2	Ryde	07-May-88	88	53,238	1,323	0.0249	1.841257	53,238	0.2776	14,780	145	0.0098	
B6-14-8 5-18-42	Port Chicago Benicia	11&17-May-88	88	106,916	1,443	0.0135		Ryde used as control instead of Port Chicago or Benicia					
6-31-4	Port Chicago	29-Jun-88	91	54,151	1,031	0.0190		Ryde used as control instead of Port Chicago or Benicia					
5-19-39	Battle Creek	09-May-88	84	51,823	398	0.0078	0.566062	29,341	0.2741	8,042	45	0.0056	
5-19-40	RBDD	10-May-88	84	52,796	467	0.0088	0.655379	34,601	0.2741	9,484	37	0.0039	
5-19-41	Princeton	11-May-88	85	52,771	413	0.0078	0.579871	30,600	0.2724	8,336	43	0.0052	
B6-14-2&3	Courtland	03-May-88	76	107,249	1,186	0.0111	0.820729	88,023	0.2747	24,177	154	0.0064	
6-31-1	Ryde	04-May-88	86	52,741	1,078	0.0204	1.001532	52,741	0.2789	14,711	104	0.0071	
B6-14-6&7	Miller Park	05-May-88	78	102,738	1,098	0.0107	0.790432	81,206	0.2747	22,310	14[illegible]	0.0063	
B6-14-4&5	Courtland	06-May-88	78	102,480	938	0.0091	0.676726	69,351	0.2538	17,603	147	0.0084	
6-62-58&60	Courtland	21-Jun-88	87	106,801	1,037	[illegible]0087	0.718743	76,834	0.2778	21,343	39	0.0018	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-62-63	Ryde	22-Jun-86	84	53,881	252	0.0047	0.348017	18,671	0.2778	5,187	46	0.0089	
6-62-61&62	Miller Park	23-Jun-86	80	97,892	141	0.0014	0.106721	10,447	0.2389	2,496	15	0.0060	
6-62-50	Courtland	24-Jun-86	74	99,827	70	0.0007	0.051956	5,187	0.2778	1,441	5	0.0035	
6-31-5&6	Steamboat Sl.	24-Jun-86	86	97,317	390	0.0040	0.296829	28,890	0.2778	8,027	79	0.0098	
6-31-3	Ryde	25-Jun-86	88	53,942	285	0.0053	0.391486	21,118	0.2778	5,866	39	0.0066	
B6-11-5&6	U. Stanislaus	28-Apr-86	78	71,075	99	0.0014	0.101300	7,201	0.2782	2,020	11	0.0054	
B6-11-3&4	L. Stanislaus	28-Apr-86	79	68,786	267	0.0038	0.287501	18,783	0.2891	5,323	13	0.0024	0.00582

1987

No control release in 1987.

1988

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-62-51	Port Chicago	02-Jun-88	75	47,995	1,382	0.0288							
6-46-54 & 55	U. Tuolumne	14-Apr-88	81	99,148	1,946	0.0196	0.6816271	67,582	0.1142	7,718	35	0.0045	
6-46-48 to 50 & 53	U. Stanislaus	28-Apr-88	80	108,273	1,457	0.0135	0.467334	50,600	0.1292	6,537	37	0.0057	
6-46-56 & 57	L. Tuolumne	14-Apr-88	81	103,474	2,080	0.0201	0.6910557	71,506	0.0918	6,564	20	0.0030	
6-46-45 & 46	L. Stanislaus	29-Apr-88	80	106,099	2,149	0.0203	0.7034174	74,632	0.1381	10,307	60	0.0058	
H5-4-2&3	Battle Creek	13-May-88	87	53,592	650	0.0121	0.421213	22,574	0.1389	3,135	30	0.0096	
H5-4-4&5	RBDD	13-May-88	87	54,508	808	0.0148	0.514820	28,061	0.1389	3,897	26	0.0067	
H5-4-6&7	Princeton	14-May-88	86	46,388	1,015	0.0219	0.759896	35,250	0.1389	4,896	10	0.0020	
6-62-43	Courtland	27-May-88	81	98,096	1,682	0.0171	0.599349	58,781	0.1388	8,154	39	0.0048	
6-62-46	Ryde	30-May-88	81	101,320	1,978	0.0195	0.678326	68,728	0.1388	9,539	74	0.0078	
6-62-49	Lower Old R.	31-May-88	78	98,000	645	0.0066	0.228562	22,400	0.1387	3,106	26	0.0084	
6-62-47	N. Fork Mok.	29-May-88	74	101,948	1,308	0.0128	0.444885	45,356	0.1135	5,147	33	0.0064	
6-62-48	S. Fork Mok.	30-May-88	77	102,955	884	0.0086	0.331909	34,173	0.1149	3,926	24	0.0061	
6-46-58 B6-11-1	Dos Reis	29-May-88	98	95,585	2,068	0.0216	0.751283	71,810	0.1387	9,961	35	0.0035	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-46-56 B6-11-2	U. Old River	30-May-86	82	100,181	1,139	0.0114	0.394845	39,558	0.1387	5,485	21	0.0038	0.00581
1985													
6-62-45	Port Chicago	13-May-85	78	48,143	465	0.0097							
5-39-4 5-40-4 5-41-4 H5-1-5 5-6-16	Battle Creek	14-May-85	86	65,279	65	0.0010	0.103091	6,730	0.1389	935	13	0.0139	
5-9-47 5-42-4 5-43-4 H5-1-6	RBDD	14-May-85	88	65,615	126	0.0019	0.198814	13,045	0.1389	1,812	21	0.0116	
5-8-48&49 H5-1-7	Princeton	15-May-85	89	65,522	173	0.0026	0.271704	17,811	0.1389	2,488	10	0.0040	
6-62-38 to 41	Courtland	10-May-85	81	100,628	367	0.0036	0.398181	40,067	0.1389	5,565	37	0.0066	
6-62-42	Lower Old R.	08-May-85	84	105,289	232	0.0022	0.228131	24,020	0.1388	3,336	20	0.0060	
6-62-35	Ryde	11-May-85	81	107,181	824	0.0086	0.862720	95,865	0.1389	13,267	88	0.0066	
6-62-34	S. Fork Mok.	07-May-85	79	100,389	317	0.0032	0.326839	32,820	0.1389	4,556	25	0.0055	
6-62-36	N. Fork Mok.	09-May-85	79	101,236	585	0.0058	0.577821	58,496	0.1388	8,124	30	0.0037	0.00725
1984													
6-62-31 & 37	Port Chicago	29-Jun-84	82	42,000	315	0.0075							
6-62-27	Courtland	11-Jun-84	82	62,604	400	0.0064	0.851918	53,333	0.1083	5,827	37	0.0063	
6-62-29 6-42-9	Ryde	13-Jun-84	77	59,998	267	0.0045	0.583353	35,000	0.1122	3,984	38	0.0095	
6-62-33	Lower Old R.	15-Jun-84	73	64,896	40	0.0006	0.082183	5,333	0.1129	602	9	0.0150	
6-62-28 6-42-8	S. Fork Mok.	12-Jun-84	80	56,297	350	0.0062	0.829084	46,667	0.1086	5,067	33	0.0065	
6-60-40 & 41	Below RBDD	02-Jun-84	88	102,888	2,207	0.0215	2.880586	Unusually high recovery rate - not used in calculation					
6-60-42 & 43	Battle Creek	09-May-84	80	100,221	1,770	0.0177	2.354786	Unusually high recovery rate - not used in calculation					
6-60-38 & 39	Knights Landing	08-May-84	87	98,751	1,865	0.0189	2.639836	Unusually high recovery rate - not used in calculation					

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Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-62-32	N. Fork Mok.	14-Jun-84	77	59,808	266	0.0044	0.593009	35,467	0.0933	3,308	24	0.0073	
6-48-22&23	Thornton	22-Jun-84	77	95,000	78	0.0008	0.109474	10,400	0.1306	1,358	16	0.0118	0.00939
1983													
6-62-30	Port Chicago	23-May-83	82	43,374	129	0.0030							
6-60-36 & 37	Battle Creek	02-Jun-83	76	87,890	168	0.0019	0.642702	56,487	0.0676	3,819	25	0.0065	
6-60-32 & 33	Knights Landing	02-Jun-83	74	92,085	128	0.0014	0.467370	43,038	0.0798	3,434	76	0.0221	
6-60-34 & 35	Below RBDD	02-Jun-83	78	89,841	92	0.0010	0.344313	30,933	0.0719	2,224	26	0.0117	
6-62-24	Courtland	16-May-93	78	96,708	428	0.0044	1.486093	Unusually high recovery rate - not used in calculation					
6-62-23	Isleton	20-May-83	81	92,693	368	0.0040	1.334875	Unusually high recovery rate - not used in calculation					
6-62-25	L. Mokelumne	17-May-83	79	83,435	270	0.0032	1.088066	Unusually high recovery rate - not used in calculation					
6-62-26	Lower Old R.	17-May-83	80	89,500	99	0.0011	0.371922	33,287	0.0962	3,202	23	0.0072	0.00718
1982													
6-62-19	Port Chicago	17-May-82	83	86,877	782	0.0090							
6-60-26 & 27	Battle Creek	05-Jun-82	80	84,702	750	0.0089	0.983707	83,322	0.0678	5,649	64	0.0113	
6-60-28 & 29	Below REDD	05-May-82	82	88,125	729	0.0083	0.919023	80,989	0.0815	6,601	69	0.0105	
6-60-30 & 31	Knights Landing	05-May-82	81	89,275	699	0.0078	0.869852	77,656	0.0981	7,618	91	0.0119	
6-62-20	Discov. Park	11-May-82	76	85,885	1,282	0.0149	1.658322	Unusually high recovery rate - not used in calculation					
6-62-18	Discov. Park	12-May-82	83	89,760	1,085	0.0121	1.342605	Unusually high recovery rate - not used in calculation					
6-62-21	Discov. Park	04-Jun-82	76	60,822	382	0.0064	0.716017	43,550	0.1173	5,108	30	0.0059	
6-46-28	Dos Reis	24-Apr-82	67	48,227	552	0.0114	1.271589	Unusually high recovery rate - not used in calculation					
6-46-17	U. Merced River	22-Apr-82	68	49,217	426	0.0087	0.966110	47,549	0.0806	3,830	19	0.0050	0.00496
1981													
6-62-15	Port Chicago	08-Jun-81	90	78,339	2,196	0.0280							
5-5-58	Cayote Creek	08-May-81	82	11,031	155	0.0141	0.501259	5,529	0.1389	768	1	0.0013	
5-5-57	Cayote Creek	13-May-81	88	10,823	177	0.0164	0.583407	6,314	0.1389	877	3	0.0034	

Appendix 1. Cont.

Tag Code	Release Site	Release Date	Size at Release (mm)	Number Released	Ocean Recov.	Ocean Recov. Rate	Survival to Chipps	# surviving to Chipps	Time Fraction	Number available for capture	Number Captured	(By Release) Trawl Efficiency	(By Year) Mean Trawl Efficiency
6-60-20	Knights Landing	18-Jun-81	77	43,059	175	0.0041	0.144984	6,243	0.1111	694	3	0.0043	
6-60-21	Knights Landing	18-Jun-81	77	43,562	246	0.0056	0.201453	8,776	0.0417	366	2	0.0055	
6-60-16	Battle Creek	18-May-81	80	86,213	281	0.0033	0.116273	10,024	0.0833	835	5	0.0060	
6-60-17	RBDD	18-May-81	79	84,967	394	0.0046	0.165421	14,055	0.0833	1,171	8	0.0068	
6-62-14&17	Discovery Park	04-Jun-81	90	140,250	47	0.0003	0.011855	1,677	0.1111	186	1	0.0054	
6-58-23	Rio Vista	02-Jun-81	84	8,864	219	0.0247	0.881374	7,812	0.1194	933	9	0.0096	0.00696
1980													
6-62-9 & 12	Port Chicago	10 & 13-Jun-80	92	168,143	3,669	0.0218							
6-62-7	F.R. Hatchery	03-Jun-80	91	88,335	292	0.0033	0.151489	13,382	0.1356	1,814	15	0.0083	
6-62-8	Discovery Park	03-Jun-80	88	98,586	951	0.0096	0.442075	43,582	0.1362	5,936	34	0.0057	
6-62-10	F.R. Hatchery	05-Jun-80	90	88,516	497	0.0056	0.257315	22,777	0.1374	3,129	15	0.0048	
6-62-11	Discovery Park	05-Jun-80	90	84,843	678	0.0080	0.367088	31,071	0.1361	4,228	33	0.0078	0.00665

Appendix 2 Chipps Island tag summary, survival calculations, expanded fish facility recoveries, and expanded ocean recoveries updated through 1996 for coded wire tagged fish recovered 1978-1996. No ocean recoveries are reported for 1996.

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
1996																
Late-fall run releases																
Upper Sacramento River and Tributaries																
5-36-27	Battle Creek (CNFH)		N/A	N/A	61,790	122	12/20/1995	12/20/1995	2	155	0.1076	0.04		0	24	
5-41-16	Battle Creek (CNFH)		N/A	N/A	64,794	116	12/28/1995	01/24/1996	3	3101	0.0789	0.06		0	9	
	Total	11/09/1995			126,584		12/20/1995	01/24/1996	5	3256	0.0628		0.06			
5-41-07	Battle Creek (CNFH)		N/A	N/A	77,196	123	12/20/1995	01/29/1996	17	4256	0.0721	0.40		24	38	
5-41-09	Battle Creek (CNFH)		N/A	N/A	63,618	126	12/28/1995	02/01/1996	6	4701	0.0807	0.14		36	24	
	Total	12/08/1995			140,814		12/20/1995	02/01/1996	23	4835	0.0763		0.28			
5-34-16	Battle Creek (CNFH)		N/A	N/A	61,858	121	01/11/1996	03/15/1996	31	9027	0.0984	0.58		72	196	
5-36-18	Battle Creek (CNFH)		N/A	N/A	133,985	134	01/12/1996	03/26/1996	56	9927	0.0919	0.59		108	631	
	Total	01/02/1996			195,843		01/11/1996	03/26/1996	87	10027	0.0916		0.63			
5-41-17	Battle Creek (CNFH)		N/A	N/A	67,737	143	01/17/1996	03/21/1996	35	8526	0.0911	0.74		84	276	
5-41-18	Battle Creek (CNFH)		N/A	N/A	64,801	110	01/17/1996	03/07/1996	16	6926	0.0943	0.34		12	28	
5-41-08	Battle Creek (CNFH)		N/A	N/A	68,931	132	01/14/1996	03/04/1996	28	7126	0.0870	0.54		60	311	
	Total	01/03/1996			201,469		01/14/1996	03/21/1996	79	9126	0.0932		0.55			
5-41-19	Battle Creek (CNFH)	01/10/1996	N/A	N/A	67,076	114	01/21/1996	03/25/1996	13	7906	0.0845	0.30		36	37	
5-36-28	Battle Creek (CNFH)	01/11/1996	N/A	N/A	65,457	127	01/19/1996	03/21/1996	24	8106	0.0894	0.53		72	126	
Sacramento-San Joaquin Estuary																
5-41-12	Courtland (CNFH)	01/09/1996	53	52	34,961	131	01/15/1996	02/13/1996	26	5340	0.1236	0.78		72	473	
5-41-13	Georgiana Sl. (CNFH)	01/10/1996	55	52	33,670	125	01/19/1996	02/16/1996	5	4720	0.1130	0.17		180	605	
5-41-14	Ryde (CNFH)	01/11/1996	52	51	30,494	122	01/17/1996	01/27/1996	21	2160	0.1364	0.66		12	0	
5-41-11	Port Chicago (CNFH)	01/11/1996	NA	NA	34,596	145	01/17/1996	01/28/1996	20	-	-			0	0	
Fall run releases																
Upper Sacramento River and Tributaries																
5-01-02-01-14	Battle Creek (CNFH)	03/14/1996	N/A	N/A	295,384	65	03/29/1996	05/26/1996	82	9800	0.1130	0.24		0	4	
5-01-02-01-15	Battle Creek (CNFH)	03/28/1996	N/A	N/A	308,443	68	04/08/1996	05/27/1996	89	8940	0.1242	0.30		0	0	
6-01-14-05-13	Feather River (FRH)		N/A	N/A	51,841	58	04/17/1996	05/20/1996	27	6740	0.1377	0.48		0	0	
6-01-14-05-14	Feather River (FRH)		N/A	N/A	57,529	58	04/30/1996	05/20/1996	29	4140	0.1389	0.48		0	0	
6-01-14-05-15	Feather River (FRH)		N/A	N/A	50,724	58	04/28/1996	05/17/1996	22	3940	0.1388	0.41		0	0	
6-01-14-06-05	Feather River (FRH)		N/A	N/A	53,612	58	04/15/1996	05/17/1996	32	6540	0.1376	0.56		0	0	
	Total	04/05/1996			213,706		04/15/1996	05/20/1996	110	7340	0.1418		0.47			
5-01-02-02-01	Battle Creek (CNFH)	04/23/1996	N/A	N/A	268,980	80	05/01/1996	05/28/1996	125	5540	0.1374	0.44		0	0	
6-01-06-01-03	Feather River (FRH)	05/03/1996	N/A	N/A	100,033	80	05/08/1996	05/30/1996	57	4540	0.1371	0.54		0	0	
6-01-14-06-01	Yuba City (FRH)		N/A	N/A	50,890	87	05/19/1996	05/31/1996	58	2800	0.1388	1.07		0	0	
6-01-14-06-02	Yuba City (FRH)		N/A	N/A	51,810	87	05/18/1996	05/31/1996	70	2800	0.1389	1.27		0	0	

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS		EXPANDED OCEAN RECOVERIES
														CVP	SWP	
6-01-14-06-03	Yuba City (FRH)		N/A	N/A	51,300	87	05/19/1996	05/30/1996	67	2400	0.1389	1.22		0	0	
6-01-14-06-04	Yuba City (FRH)		N/A	N/A	50,371	87	05/19/1996	06/03/1996	53	2760	0.1198	1.14		0	0	
	Total	05/15/1996			204,171		05/19/1996	06/03/1996	248	2760	0.1198		1.32			
Sacramento-San Joaquin Estuary																
6-1-13-1-7	Woodbridge Dam (MOK)	04/10/1996	N/A	N/A	3,852	93	05/23/1996	05/23/1996	1	200	0.1389	0.24		0	0	
6-1-14-5-5	Turner Cut (FRH)	04/17/1996	52	63	50,103	79	04/30/1996	05/18/1996	5	3140	0.1363	0.10		12	0	
6-01-06-01-08	Miller Park (FRH)	04/25/1996	48	57	49,706	81	04/30/1996	05/18/1996	58	3340	0.1364	1.11		0	0	
6-01-06-02-02	Miller Park (FRH)	05/06/1996	58	65	49,881	83	05/10/1996	05/23/1996	30	2740	0.1358	0.58		12	0	
6-01-06-01-11	Turner Cut (FRH)		56	70	48,100	82	05/09/1996	05/13/1996	3	940	0.1306	0.06		12	0	
6-01-06-01-12	Turner Cut (FRH)		62	70	49,923	84	05/11/1996	05/11/1996	1	180	0.1250	0.02		12	0	
	Total	05/02/1996			98,023		05/09/1996	05/13/1996	4	940	0.1306		0.04			
6-1-14-5-6	Benicia (FRH)	05/07/1996	51	66	51,288	84	05/11/1996	05/18/1996	2	-	-			0	0	
6-02-16	Mokelumne (MOK)		N/A	N/A	49,946	90	05/20/1996	06/03/1996	14	2980	0.1185	0.31		0	24	
6-02-17	Mokelumne (MOK)		N/A	N/A	52,123	91	05/20/1996	05/25/1996	11	1200	0.1389	0.20		0	0	
	Total	05/15/1996			102,069		05/20/1996	06/03/1996	25	2980	0.1185		0.27			
6-02-20	Mokelumne (MOK)		N/A	N/A	52,382	107	06/08/1996	06/08/1996	1	200	0.1389	0.02		12	0	
6-02-21	Mokelumne (MOK)		N/A	N/A	52,205	102	06/08/1996	06/08/1996	1	200	0.1389	0.02		0	4	
	Total	06/04/1996			104,587		06/08/1996	06/08/1996	2	200	0.1389		0.02			
6-01-06-01-14	Mossdale (FRH)		49.5	59.5	49,024	78	-	-	0	-	-			480	32	
6-01-06-01-15	Mossdale (FRH)		49.5	59.5	51,718	78	04/25/1996	04/27/1996	2	600	0.1389	0.04		576	2	
	Total	04/15/1996			100,742		04/25/1996	04/27/1996	2	600	0.1389		0.02			
6-01-06-01-13	Jersey Point (FRH)	04/18/1996	50	62	50,041	78	04/21/1996	06/03/1996	25	6300	0.1310	0.50		0	0	
6-01-06-02-01	Mossdale (FRH)		61.5	64	50,462	81	05/07/1996	05/07/1996	1	200	0.1389	0.02		552	70	
6-01-06-02-05	Mossdale (FRH)		61.5	64	49,194	81	-	-	0	-	-			780	35	
	Total	04/30/1996			99,656		05/07/1996	05/07/1996	1	200	0.1389		0.01			
6-01-06-02-03	Dos Rios (FRH)		52	63	49,848	83	05/08/1996	05/23/1996	2	2940	0.1381	0.04		0	0	
6-01-06-01-10	Dos Rios (FRH)		52	63	48,770	84	05/11/1996	05/11/1996	1	180	0.1250	0.02		0	0	
	Total	05/01/1996			98,618		05/08/1996	05/23/1996	2	2940	0.1381		0.02			
6-01-11-04-12	Dos Rios (MRFF)		57	63	25,530	84	06/06/1996	06/10/1996	2	600	0.1388	0.07		0	0	
6-01-11-04-13	Dos Rios (MRFF)		57	63	28,079	84	05/05/1996	06/07/1996	2	600	0.1389	0.07		0	0	
6-01-11-04-14	Dos Rios (MRFF)		57	63	18,459	84	06/06/1996	06/06/1996	1	200	0.1389	0.05		0	0	
6-01-11-04-15	Dos Rios (MRFF)		57	63	35,893	84	06/06/1996	06/12/1996	5	980	0.1381	0.13		0	0	
	Total	05/01/1996			107,961		05/05/1996	06/12/1996	10	1580	0.1372		0.09			
6-01-06-01-09	Jersey Point (FRH)	05/03/1996	51	64	50,820	87	05/06/1996	05/19/1996	22	2740	0.1358	0.41		12	0	
6-01-11-05-01	Jersey Point (MRFF)	05/03/1996	50	68	51,737	77	05/06/1996	05/22/1996	39	3540	0.1388	0.72		0	0	
6-01-06-02-06	Dos Rios (FRH)	05/09/1996	54	60	50,168	83	-	-	0	-	-			0	8	

Appendix 2. Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS		EXPANDED OCEAN RECOVERIES
														CVP	SWP	
6-01-06-02-04	Dos Rais (FRH)	05/18/1996	51	62	50,243	88	-	-	0	-	-			12	36	
6-02-18	Jersey Point (MOK)		N/A	N/A	50,832	87	05/22/1996	05/29/1996	88	1800	0.1389	1.62		0	0	
6-02-10	Jersey Point (MOK)		N/A	N/A	52,389	90	05/21/1996	05/30/1996	107	2000	0.1389	1.91		0	0	
	Total	05/20/1996			103,221		05/21/1996	05/30/1996	195	2000	0.1389		1.77			
Upper San Joaquin River and Tributaries																
6-01-11-04-08	Upper Merced (MRFF)		N/A	N/A	21,011	80	-	-	0	-	-			36	1	
6-01-11-04-09	Upper Merced (MRFF)		N/A	N/A	21,089	80	-	-	0	-	-			12	7	
6-01-11-04-10	Upper Merced (MRFF)		N/A	N/A	22,636	80	05/08/1996	05/08/1996	1	200	0.1389	0.04		144	0	
6-01-11-04-11	Upper Merced (MRFF)		N/A	N/A	21,693	80	-	-	0	-	-			96	1	
	Total	04/25/1996			86,411		05/08/1996	05/08/1996	1	200	0.1389		0.01			
6-01-11-05-03	Lower Merced (MRFF)		N/A	N/A	21,705	93	-	-	0	-	-			36	3	
6-01-11-05-04	Lower Merced (MRFF)		N/A	N/A	22,019	93	05/05/1996	05/05/1996	1	200	0.1389	0.04		72	1	
6-01-11-05-05	Lower Merced (MRFF)		N/A	N/A	20,613	93	-	-	0	-	-			144	8	
	Total	04/26/1996			64,337		05/05/1996	05/05/1996	1	200	0.1389		0.01			
6-01-11-05-06	Upper Tuolumne (MRFF)		N/A	N/A	21,601	88	-	-	0	-	-			168	19	
6-01-11-05-07	Upper Tuolumne (MRFF)		N/A	N/A	22,861	88	05/02/1996	05/06/1996	2	1000	0.1389	0.08		84	9	
6-01-11-05-08	Upper Tuolumne (MRFF)	04/26/1996	N/A	N/A	22,984	88	05/06/1996	05/06/1996	1	200	0.1389	0.04		132	26	
	Total				67,446		05/02/1996	05/06/1996	3	1000	0.1389		0.04			
6-01-11-05-09	Upper Tuolumne (MRFF)		N/A	N/A	22,789	90	05/02/1996	05/02/1996	1	200	0.1389	0.04		156	13	
6-01-11-05-10	Upper Tuolumne (MRFF)		N/A	N/A	27,819	90	05/01/1996	05/08/1996	3	1800	0.1389	0.10		204	2	
	Total	04/27/1996			50,608	90	05/01/1996	05/08/1996	4	1800	0.1389		0.07			
1995																
Late-fall run releases																
Upper Sacramento River and Tributaries																
5-36-22	Battle Creek (CNFH)	11/10/1994	N/A	N/A	61,673	120	12/06/1994	01/21/1995	19	8435	0.1246	0.32		36	55	263
5-37-42	Battle Creek (CNFH)	12/07/1994	N/A	N/A	62,356	127	12/22/1994	01/25/1995	27	8034	0.1197	0.47		60	165	276
5-35-48	Battle Creek (CNFH)		N/A	N/A	56,340	121	01/11/1995	03/03/1995	14	8797	0.0908	0.38		12	50	244
5-36-20	Battle Creek (CNFH)		N/A	N/A	125,754	138	01/11/1995	03/17/1995	64	7829	0.0824	0.80		36	427	1698
5-36-21	Battle Creek (CNFH)		N/A	N/A	128,159	127	01/11/1995	04/07/1995	34	9228	0.0737	0.47		96	137	1258
	Total	01/05/1995			310,253		01/11/1995	04/07/1995	112	9228	0.0737		0.64			
5-37-43	Battle Creek (CNFH)	01/11/1995	N/A	N/A	62,847	114	01/18/1995	03/08/1995	20	5797	0.0805	0.51		12	44	330
Sacramento-San Joaquin Estuary																
5-34-25	Georgiana Sl. (CNFH)	12/05/1994	N/A	N/A	31,532	112	12/19/1994	01/06/1995	4	2880	0.1053	0.16		48	39	12
5-34-28	Isleton (CNFH)	12/05/1994	N/A	N/A	30,220	115	12/11/1994	01/03/1995	15	3879	0.1122	0.57		0	8	27
6-25-25	Georgiana Sl. (CNFH)	01/04/1995	N/A	N/A	31,328	128	01/12/1995	01/18/1995	2	1000	0.1389	0.08		120	717	101

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS		EXPANDED OCEAN RECOVERIES
														CVP	SWP	
6-25-24	Isleton (CNFH)	01/05/1995	N/A	N/A	31,557	132	01/08/1995	01/14/1995	13	1200	0.1388	0.38		48	184	246
Fall run releases																
Upper Sacramento River and Tributaries																
5-1-1-12-4	Below RBDD (CNFH)		N/A	N/A	50,410	48	04/25/1995	05/30/1995	13	7016	0.1353	0.25		0	0	394
5-1-1-12-5	Below RBDD (CNFH)		N/A	N/A	45,472	48	04/24/1995	05/21/1995	30	5399	0.1339	0.64		0	0	327
	Total	03/10/1995			95,882		04/24/1995	05/30/1995	43	7195	0.1350		0.43			
6-1-6-1-4	Feather River Hatchery		48	50	54,304	48	04/25/1995	05/29/1995	14	6816	0.1352	0.25		0	0	366
6-1-6-1-5	Feather River Hatchery		48	50	52,394	48	04/10/1995	05/22/1995	19	7358	0.1199	0.40		0	0	331
6-1-6-1-6	Feather River Hatchery		48	50	51,631	48	04/26/1995	05/21/1995	18	5020	0.1341	0.34		0	0	480
6-1-6-1-7	Feather River Hatchery		48	50	38,635	48	04/24/1995	05/26/1995	14	6395	0.1348	0.35		0	0	245
	Total	04/03/1995			196,964		04/10/1995	05/29/1995	65	6755	0.1218		0.35			
5-1-1-12-6	Battle Creek (CNFH)		N/A	N/A	52,442	79	05/02/1995	05/18/1995	20	2820	0.1309	0.38		0	0	513
5-1-1-12-7	Battle Creek (CNFH)		N/A	N/A	49,638	75	05/01/1995	05/30/1995	28	5816	0.1348	0.51		0	0	482
5-1-1-12-8	Battle Creek (CNFH)		N/A	N/A	50,109	64	05/05/1995	06/23/1995	12	9416	0.1306	0.24		0	0	337
	Total	04/24/1995			152,187		05/01/1995	06/23/1995	60	10216	0.1314		0.38			
6-25-26	Yuba City Ramp (FRH)		N/A	N/A	52,249	77	05/22/1995	06/04/1995	22	2798	0.1387	0.39		0	0	578
6-25-27	Yuba City Ramp (FRH)		N/A	N/A	53,398	77	05/23/1995	06/07/1995	22	3198	0.1387	0.39		0	0	705
6-25-28	Yuba City Ramp (FRH)		N/A	N/A	53,486	77	05/22/1995	06/08/1995	24	3588	0.1387	0.42		0	0	829
6-25-29	Yuba City Ramp (FRH)		N/A	N/A	42,525	77	05/23/1995	06/08/1995	16	3398	0.1387	0.25		0	0	697
	Total	05/18/1995			201,658		05/22/1995	06/08/1995	84	3588	0.1387		0.39			
Sacramento-San Joaquin Estuary																
6-63-47	L. Mokelumne (MOK)	10/17/1994	N/A	N/A	49,882	180	10/28/1994	12/28/1994	2	7079	0.0783	0.07		38	30	117
6-63-48	L. Mokelumne (MOK)	10/18/1994	N/A	N/A	48,142	180	10/29/1994	11/14/1994	4	1800	0.0558	0.19		12	38	185
6-1-14-5-1	Mossdale (FRH)		51	57	50,849	70	04/25/1995	05/24/1995	10	5820	0.1347	0.19		1213	12	187
6-1-14-4-14	Mossdale (FRH)		51	57	50,120	70	04/28/1995	05/17/1995	10	4220	0.1332	0.19		1435	24	224
	Total	04/17/1995			100,969		04/25/1995	05/24/1995	20	5880	0.1389		0.19			
6-1-14-4-12	Dos Reis (FRH)	04/17/1995	51	57	50,848	70	05/03/1995	05/26/1995	8	4218	0.1331	0.15		0	0	188
6-2-11	New Hope Landing (MOK)		N/A	N/A	48,345	80	04/25/1995	05/18/1995	27	4820	0.1337	0.54		0	0	382
6-2-12	New Hope Landing (MOK)		N/A	N/A	49,531	80	04/25/1995	05/21/1995	23	5220	0.1343	0.45		0	0	353
	Total	04/18/1995			97,876		04/25/1995	05/21/1995	50	5220	0.1343		0.49			
6-1-14-4-13	Jersey Point (FRH)	04/19/1995	51	60	50,779	70	04/24/1995	05/11/1995	29	3579	0.1381	0.48		0	0	254
6-2-13	New Hope Landing (MOK)		N/A	N/A	49,637	83	05/02/1995	05/17/1995	26	3020	0.1311	0.52		0	0	325
6-2-14	New Hope Landing (MOK)		N/A	N/A	48,825	83	05/01/1995	05/20/1995	24	3820	0.1329	0.47		0	0	306
	Total	04/25/1995			98,462		05/01/1995	05/20/1995	50	3820	0.1326		0.43			
6-1-14-5-2	Ryde (FRH)	05/01/1995	57	59	51,997	81	05/03/1995	05/22/1995	47	3820	0.1326	0.89		0	0	644

Appendix 2 Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
6-1-14-5-3	Miller Park (FRH)	05/01/1995	59.5	58.5	50,292	81	05/04/1995	05/21/1995	32	3420	0.1319	0.63		12	0	743
6-31-50	Mossdale (FRH)		49	62	52,297	78	05/12/1995	05/24/1995	10	2420	0.1293	0.19		561	20	178
6-31-51	Mossdale (FRH)		49	62	50,265	75	05/12/1995	06/02/1995	3	4216	0.1331	0.06		540	54	166
	Total	05/05/1995			102,562		05/12/1995	06/02/1995	13	4216	0.1331		0.12			
6-31-47	Dos Reis (FRH)	05/05/1995	50	63	52,097	76	05/11/1995	06/07/1995	21	5416	0.1343	0.39		0	0	382
6-1-14-6-4	Mossdale (FRH)		50	63	52,703	79	05/29/1995	05/29/1995	1	200	0.1389	0.02		720	66	157
6-31-48	Mossdale (FRH)		50	63	51,422	76	05/21/1995	05/29/1995	7	1798	0.1388	0.13		780	62	161
	Total	05/17/1995			104,125		05/21/1995	05/29/1995	8	1798	0.1388		0.07			
6-31-49	Dos Reis (FRH)	05/17/1995	58	65	51,885	77	05/23/1995	06/02/1995	9	2196	0.1388	0.16		12	0	211
6-2-11	Thornton (MOK)	06/15/1995	N/A	N/A	51,757	100	06/18/1995	06/25/1995	18	1400	0.1389	0.33		0	0	213
6-29-32	Rodeo (FRH)		N/A	N/A	147,816	N/A	-	-	0	-	-			0	0	627
6-29-33	Rodeo (FRH)		N/A	N/A	139,443	N/A	-	-	0	-	-			0	0	1987
	Total	06/16/1995			287,259											
Upper San Joaquin River and Tributaries																
6-46-23	Merced hatchery		N/A	N/A	7,586	169	12/12/1994	12/12/1994	1	200	0.1389	0.12		282	110	22
6-46-24	Merced hatchery		N/A	N/A	10,021	164	-	-	0	-	-			84	86	23
6-46-25	Merced hatchery		N/A	N/A	8,904	164	12/19/1994	12/19/1994	1	200	0.1389	0.11		218	62	21
	Total	11/17/1994			26,511		12/12/1994	12/19/1994	2	1599	0.1388		0.07			
6-1-2-1-11	Merced hatchery	11/18/1994	N/A	N/A	48,889	169	12/10/1994	01/11/1995	5	5639	0.1167	0.11		2058	565	135
6-1-2-1-12	Merced hatchery		N/A	N/A	48,943	164	12/18/1994	01/24/1995	4	8634	0.1212	0.09		690	488	114
6-46-22	Merced hatchery		N/A	N/A	7,600	169	12/19/1994	12/19/1994	1	200	0.1389	0.12		189	91	6
	Total	11/28/1994			56,543		12/18/1994	01/24/1995	5	8634	0.1212		0.09			
6-1-11-4-1	Upper Merced (MRFF)		51	51	28,349	84	05/08/1995	05/29/1995	5	4216	0.1331	0.17		312	108	228
6-1-11-4-2	Upper Merced (MRFF)		51	51	27,881	84	05/21/1995	06/13/1995	3	4798	0.1388	0.10		240	146	182
6-1-11-4-3	Upper Merced (MRFF)		51	51	26,939	84	05/29/1995	06/12/1995	4	3200	0.1389	0.14		560	183	125
6-1-11-4-4	Upper Merced (MRFF)		51	51	28,138	84	05/23/1995	06/08/1995	6	2998	0.1387	0.20		384	137	115
	Total	05/03/1995			111,297		05/08/1995	06/13/1995	18	7216	0.1354		0.16			
6-1-11-4-5	Lower Merced (MRFF)		51	59	27,318	82	05/21/1995	06/03/1995	7	2798	0.1387	0.24		336	136	218
6-1-11-4-6	Lower Merced (MRFF)		51	59	27,643	82	05/21/1995	06/09/1995	4	3999	0.1389	0.14		384	125	177
6-1-11-4-7	Lower Merced (MRFF)		51	59	28,094	82	05/20/1995	05/29/1995	7	1998	0.1388	0.23		384	150	171
	Total	05/04/1995			83,018		05/20/1995	06/09/1995	18	4196	0.1389		0.20			
6-1-11-3-11	Upper Tuolumne (MRFF)		51	48	28,068	89	05/31/1995	06/13/1995	8	2800	0.1389	0.27		576	472	276
6-1-11-3-12	Upper Tuolumne (MRFF)		51	48	27,132	86	05/21/1995	06/25/1995	6	6798	0.1311	0.22		588	211	327
6-1-11-3-13	Upper Tuolumne (MRFF)		51	48	28,347	88	05/29/1995	06/14/1995	8	3400	0.1389	0.26		612	274	354
	Total	05/04/1995			83,547		05/21/1995	06/25/1995	22	6798	0.1311		0.35			
6-1-11-3-14	Lower Tuolumne (MRFF)		48	51	26,007	89	05/18/1995	06/08/1995	5	4398	0.1389	0.18		684	268	305
6-1-11-3-15	Lower Tuolumne (MRFF)		48	51	27,290	89	05/20/1995	06/26/1995	7	7198	0.1315	0.25		861	207	295
	Total	05/05/1995			53,298		05/18/1995	06/26/1995	12	7596	0.1319		0.22			

Appendix 2:   Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
1994																
Late-fall run releases																
Upper Sacramento River and Tributaries																
5-33-16	Battle Creek (CNFH)		N/A	N/A	82,884	120	01/18/1994	03/18/1994	15	5350	0.0820	0.50		48	25	273
5-33-17	Battle Creek (CNFH)		N/A	N/A	86,231	122	-	-	0	-	-			12	4	118
5-34-8	Battle Creek (CNFH)		N/A	N/A	67,845	134	01/31/1994	03/08/1994	11	3350	0.0814	0.34		36	8	237
5-34-9	Battle Creek (CNFH)		N/A	N/A	72,236	130	01/31/1994	02/25/1994	8	2382	0.0831	0.23		48	4	217
	Total	01/03/1994			248,888		01/18/1994	03/18/1994	34	5350	0.0820		0.29			
5-34-11	Battle Creek (CNFH)		N/A	N/A	78,556	124	01/31/1994	03/08/1994	7	3350	0.0814	0.19		24	2	150
5-34-12	Battle Creek (CNFH)		N/A	N/A	69,894	129	02/02/1994	03/18/1994	6	3858	0.0811	0.18		24	18	221
5-34-13	Battle Creek (CNFH)		N/A	N/A	78,861	135	01/28/1994	03/07/1994	22	3382	0.0800	0.61		84	18	488
5-34-14	Battle Creek (CNFH)		N/A	N/A	66,809	128	02/02/1994	02/23/1994	5	1882	0.0818	0.10		24	12	227
	Total	01/04/1994			292,670		01/28/1994	03/18/1994	38	4350	0.0805		0.29			
5-34-15	Battle Creek (CNFH)		N/A	N/A	54,248	123	01/28/1994	03/18/1994	13	3858	0.0805	0.53		144	3	220
5-34-10	Battle Creek (CNFH)		N/A	N/A	73,882	127	02/07/1994	03/18/1994	7	3171	0.0805	0.21		0	5	145
	Total	01/06/1994			128,130		01/28/1994	03/18/1994	20	3858	0.0805		0.35			
Sacramento-San Joaquin Estuary																
6-45-21	Georgiana Sl. (CNFH)	12/02/1993	N/A	N/A	33,888	110	12/12/1993	03/04/1994	5	8337	0.0888	0.28		180	78	78
6-45-22	Ryde (CNFH)	12/02/1993	N/A	N/A	34,929	120	12/08/1993	03/18/1994	37	10563	0.0726	1.00		0	10	287
5-34-17	Clifton Court F. (CNFH)	12/02/1993	N/A	N/A	12,880	124	12/01/1993	12/08/1993	4	1097	0.1232	0.33		0	3	18
Fall run releases																
Upper Sacramento River and Tributaries																
6-1-8-1-1	Feather River (FRH)	03/18/1994	48	N/A	103,808	81	04/18/1994	05/08/1994	6	4314	0.1302	0.06		0	0	180
5-1-1-8-8	Below RBDD (CNFH)		N/A	N/A	54,191	45	04/25/1994	04/28/1994	2	1000	0.1300	0.03		0	0	24
5-1-1-8-9	Below RBDD (CNFH)		N/A	N/A	57,084	45	04/23/1994	04/28/1994	3	1200	0.1300	0.05		0	0	52
	Total	03/18/1994			111,275		04/23/1994	04/28/1994	5	1400	0.1300		0.04			
5-34-27	Coleman (CNFH)		N/A	N/A	54,002	64	04/28/1994	05/01/1994	2	800	0.1300	0.03		0	0	138
5-34-28	Coleman (CNFH)		N/A	N/A	53,430	71	04/28/1994	05/08/1994	8	2200	0.1300	0.14		0	0	251
5-34-29	Coleman (CNFH)		N/A	N/A	52,463	76	04/24/1994	05/08/1994	12	3000	0.1300	0.21		0	0	418
	Total	04/14/1994			159,895		04/24/1994	05/08/1994	22	3000	0.1300		0.13			
6-1-8-1-2	Feather River (FRH)	05/03/1994	48	N/A	109,377	81	05/14/1994	05/14/1994	1	200	0.1300	0.01		0	0	97
Sacramento-San Joaquin Estuary																
6-57-62	Mokelumne River (MOK)	10/18/1993	N/A	N/A	82,398	135	11/10/1993	11/10/1993	3	200	0.1300	0.05		42	67	271
6-57-63	Mokelumne River (MOK)	10/20/1993	N/A	N/A	82,388	135	11/08/1993	11/10/1993	2	400	0.1300	0.04		134	80	348
6-1-14-3-14	Lower Old River (FRH)	04/11/1994	55	62	80,032	74	-	-	0	-	-			84	10	3

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TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
6-1-14-3-15	Mossdale (FRH)	04/11/1994	53	63	51,084	74	-	-	0	-	-			848	97	62
6-1-14-4-1	Ryde (FRH)	04/12/1994	54	63	51,819	76	04/18/1994	05/01/1994	11	2800	0.1389	0.20		0	0	375
6-1-14-4-2	Georgiana Sl. (FRH)	04/12/1994	55	62	51,486	77	04/20/1994	04/25/1994	3	1200	0.1389	0.05		0	0	214
6-1-14-4-3	Jersey Point (FRH)	04/13/1994	57	64	50,880	72	04/23/1994	05/03/1994	10	2200	0.1389	0.18		12	4	410
6-1-14-4-6	Ryde (FRH)	04/25/1994	54	62	56,136	76	04/27/1994	05/11/1994	10	3000	0.1389	0.17		0	0	864
6-1-14-4-7	Georgiana Sl. (FRH)	04/26/1994	53	62	50,236	73	05/03/1994	05/20/1994	6	3800	0.1389	0.11		0	0	151
6-1-14-4-5	Lower Old River (FRH)	04/26/1994	51	62	50,250	76	-	-	0	-	-			72	11	5
6-1-14-4-4	Mossdale (w/barrier) (FRH)	04/26/1994	48	60	50,726	77	05/11/1994	05/14/1994	2	800	0.1389	0.04		0	0	87
6-1-14-4-8	Jersey Point (FRH)	04/27/1994	51	63	53,810	78	05/02/1994	05/22/1994	16	4200	0.1389	0.28		0	0	748
6-31-41	Mossdale (w/barrier) (FRH)	05/02/1994	53	66	51,632	87	-	-	0	-	-			12	24	40
6-31-42	Miller Park (FRH)	05/03/1994	52	67	53,232	83	05/07/1994	05/15/1994	4	1800	0.1389	0.07		0	0	219
6-25-17	Benecia (FRH)	05/04/1994			102,981	88	-	-	0	-	-			0	.0	3341
6-31-43	Mossdale (w/barrier) (FRH)	05/08/1994	51	68	53,880	86	05/22/1994	05/22/1994	1	200	0.1389	0.02		0	13	31
6-48-3	New Hope Landing (MOK)		N/A	66	53,806	87	05/18/1994	05/28/1994	5	2340	0.1384	0.09		0	13	135
6-48-4	New Hope Landing (MOK)		N/A	68	49,664	82	05/18/1994	05/31/1994	6	3340	0.1384	0.11		12	19	189
	Total	05/10/1994			103,470		05/18/1994	05/31/1994	11	3180	0.1291		0.11			
6-48-1	New Hope Landing (MOK)		N/A	67	51,314	87	05/27/1994	05/31/1994	9	1000	0.1389	0.19		0	0	386
6-48-2	New Hope Landing (MOK)		N/A	67	51,418	88	05/27/1994	06/06/1994	10	2200	0.1389	0.18		0	2	355
	Total	05/23/1994			102,732		05/27/1994	06/06/1994	19	2200	0.1389		0.17			
6-31-45	Miller Park (FRH)	05/24/1994	48	71	48,970	91	-	-	0	-	-			0	0	10
	Upper San Joaquin River and Tributaries															
6-45-16	Merced hatchery		56	56	[illegible]	105	12/14/1993	05/02/1994	3	15247	0.0786	0.16		1836	243	223
6-45-17	Merced hatchery		56	56	[illegible]	105	04/01/1994	04/01/1994	1	200	0.1389	0.03		1817	225	208
	Total	11/08/1993			67,856		12/14/1993	05/02/1994	4	15247	0.0786		0.10			
6-1-11-2-10	Merced hatchery		53	61	26,315	86	05/01/1994	05/02/1994	2	400	0.1389	0.07		24	8	54
6-1-11-2-11	Merced hatchery		53	61	25,328	88	05/01/1994	05/01/1994	1	200	0.1389	0.04		48	1	149
6-1-11-2-12	Merced hatchery		53	61	26,632	88	05/01/1994	05/08/1994	2	1800	0.1389	0.07		24	28	80
6-1-11-2-13	Merced hatchery		53	61	17,280	88	05/18/1994	05/18/1994	1	200	0.1389	0.06		24	48	48
	Total	04/22/1994			95,555		05/01/1994	05/18/1994	6	3000	0.1389		0.06			
6-1-11-2-14	Lower Merced (MRFF)		48	62	35,017	87	-	-	0	-	-			24	15	103
6-1-11-2-18	Lower Merced (MRFF)		48	62	23,324	87	05/01/1994	05/03/1994	2	800	0.1389	0.06		48	29	43
6-1-11-3-1	Lower Merced (MRFF)		48	62	23,750	87	-	-	0	-	-			0	0	88
	Total	04/22/1994			82,091		05/01/1994	05/03/1994	2	800	0.1389		0.02			

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
6-1-11-3-2	Upper Tuolumne (MRFF)		53	51	50,859	85	05/06/1994	05/14/1994	2	2000	0.1389	0.03		12	7	86
6-1-11-3-3	Upper Tuolumne (MRFF)		53	51	4,281	85	05/12/1994	05/12/1994	1	200	0.1389	0.22		12	22	86
6-1-11-3-4	Upper Tuolumne (MRFF)		53	51	28,274	85	-	-	0	-	-			0	4	82
	Total	04/23/1994			83,414		05/06/1994	05/14/1994	3	2000	0.1389		0.03			
6-1-11-3-5	Lower Tuolumne (MRFF)		48	62	36,429	82	06/08/1994	06/08/1994	1	200	0.1389	0.03		48	0	109
6-1-11-3-6	Lower Tuolumne (MRFF)		48	62	13,626	82	06/08/1994	06/08/1994	1	200	0.1389	0.07		24	14	48
	Total	04/24/1994			50,055		06/08/1994	06/08/1994	2	600	0.1389		0.04			
1993																
Late-fall run releases																
Upper Sacramento River and Tributaries																
5-31-21	Battle Creek (CNFH)		N/A	N/A	62,121	N/A	-	-	0	-	-			12	254	900
5-31-22	Battle Creek (CNFH)		N/A	N/A	155,214	N/A	-	-	0	-	-			24	575	1516
5-29-59	Battle Creek (CNFH)		N/A	N/A	52,245	N/A	-	-	0	-	-			24	94	438
5-29-62	Battle Creek (CNFH)		N/A	N/A	52,666	N/A	-	-	0	-	-			24	73	389
	Total	01/04/1993			322,246											
Fall run releases																
Upper Sacramento River and Tributaries																
5-1-1-8-1	Below RBDD (CNFH)		N/A	N/A	60,509	53	04/18/1993	05/06/1993	22	3079	0.1345	0.35		0	0	439
5-1-1-8-2	Below RBDD (CNFH)		N/A	N/A	63,238	53	04/18/1993	05/14/1993	21	5079	0.1357	0.32		0	0	433
	Total	03/10/1993			123,747		04/18/1993	05/14/1993	43	5279	0.1368		0.33			
6-1-14-11-1	Battle Creek (CNFH)		N/A	50	31,005	72	04/22/1993	06/08/1993	18	3313	0.1353	0.85		0	4	588
6-1-14-11-2	Battle Creek (CNFH)		N/A	50	28,071	72	04/21/1993	05/08/1993	27	3613	0.1355	0.90		12	0	508
	Total	04/13/1993			59,076		04/21/1993	06/08/1993	45	3483	0.1348		0.73			
5-1-1-8-3	Battle Creek (CNFH)		N/A	54	60,301	62	05/05/1993	06/07/1993	22	6615	0.1351	0.35		0	0	606
5-1-1-8-4	Battle Creek (CNFH)		N/A	54	61,615	75	05/03/1993	06/02/1993	57	6015	0.1347	0.89		0	0	1283
5-1-1-8-5	Battle Creek (CNFH)		N/A	54	91,981	79	05/03/1993	05/28/1993	61	5220	0.1394	0.62		0	0	1363
	Total	04/28/1993			213,897		05/03/1993	06/07/1993	130	6865	0.1349		0.69			
Sacramento-San Joaquin Estuary																
6-1-14-3-6	Mossdale (FRH)	04/08/1993	52	64	50,016	59	04/28/1993	05/20/1993	2	4836	0.1371	0.04		1272	40	38
6-1-14-3-8	Lower Old River (FRH)	04/13/1993	56	62	52,747	64	-	-	0	-	-			756	170	39
6-1-14-3-5	Benicia (split release)(FRH)	7&15-Apr-93	55	60,61	53,088	58	04/14/1993	05/12/1993	12	5887	0.1384	0.22		0	0	434
6-1-14-3-9	Ryde (FRH)	04/14/1993	57	56	53,285	61	04/23/1993	05/22/1993	23	5836	0.1374	0.41		0	0	527
6-1-14-3-10	Georgiana Sl. (FRH)	04/14/1993	55	56	53,857	63	05/02/1993	05/17/1993	7	3140	0.1383	0.12		24	0	204
6-1-14-3-7	Benicia (FRH)	04/15/1993	53	61	49,336	63	04/29/1993	05/23/1993	5	-	-			0	0	531
6-1-14-11-4	Clifton Court F. (FRH)	04/21/1993	57	67	25,899	69	-	-	0	-	-			0	90	0
6-1-14-3-11	Miller Park (FRH)	04/23/1993	53	61	54,494	68	05/01/1993	05/25/1993	38	4840	0.1372	0.83		12	0	780

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
6-1-14-11-3	Rio Vista (FRH)	04/28/1993	54	61	28,056	69	04/29/1993	06/18/1993	19	8880	0.1344	0.86		24	0	326
6-1-14-3-12	Mossdale (FRH)	04/28/1993	57	64	55,742	71	05/07/1993	05/16/1993	4	2920	0.1403	0.07		1020	66	94
6-1-14-3-13	Miller Park (FRH)	05/03/1993	58	62	51,574	71	05/07/1993	06/01/1993	23	5815	0.1339	0.43		24	0	685
6-31-35	Mossdale (FRH)	05/04/1993	52	61	51,837	72	05/11/1993	05/21/1993	4	2220	0.1402	0.07		824	78	111
6-63-41	New Hope Landing (MOK)		N/A	63	50,403	78	05/13/1993	05/27/1993	15	3020	0.1388	0.28		12	12	298
6-63-42	New Hope Landing (MOK)		N/A	63	50,040	78	05/14/1993	06/04/1993	13	4215	0.1330	0.25		12	0	311
	Total	05/08/1993			100,443		05/13/1993	06/04/1993	28	4385	0.1327		0.27			
6-31-37	Ryde (FRH)	05/10/1993	58	58	49,888	75	05/13/1993	05/30/1993	43	3420	0.1319	0.85		0	0	1115
6-31-36	Georgiana Sl. (FRH)	05/12/1993	62	65	51,580	75	05/18/1993	06/08/1993	15	4385	0.1327	0.29		38	15	358
6-31-44	Benicia (FRH)	05/10/1993	58	67	54,297	67	-	-	0	-	-			0	0	1154
6-31-38	Mossdale (FRH)	05/12/1993	56	65	52,818	75	05/18/1993	05/22/1993	4	800	0.1389	0.07		1332	110	88
6-63-43	New Hope Landing (MOK)		N/A	64	49,543	87	05/28/1993	06/02/1993	4	985	0.1152	0.09		60	0	388
6-63-44	New Hope Landing (MOK)		N/A	64	48,719	87	05/27/1993	06/02/1993	6	1186	0.1180	0.13		60	0	301
	Total	05/20/1993			98,262		05/27/1993	06/02/1993	10	1186	0.1180		0.11			
6-31-39	Miller Park (FRH)	05/21/1993	51	65	49,788	80	05/25/1993	06/17/1993	18	4682	0.1329	0.36		0	0	863
6-31-40	Miller Park (FRH)	05/28/1993	55	64	50,116	82	05/31/1993	06/17/1993	40	3882	0.1388	0.75		0	16	1177
6-31-46	Benicia (FRH)	05/31/1993	48	64	51,804	88	-	-	0	-	-			0	0	1454
1992																
Fall Run Releases																
Upper Sacramento River and Tributaries																
5-28-12	Battle Creek (CNFH)		N/A	N/A	54,433	79	04/29/1992	06/21/1992	8	4809	0.1381	0.14		0	0	51
5-28-13	Battle Creek (CNFH)		N/A	N/A	49,507	78	04/28/1992	06/20/1992	9	5128	0.1370	0.17		0	0	40
5-28-14	Battle Creek (CNFH)		N/A	N/A	53,886	80	04/29/1992	06/20/1992	3	4320	0.1386	0.05		0	0	7
	Total	04/14/1992			157,826		04/28/1992	06/21/1992	20	5318	0.1388		0.12			
5-28-18	Red Bluff (CNFH)	04/15/1992	N/A	N/A	49,373	76	04/27/1992	06/15/1992	18	4820	0.1387	0.35		0	0	38
5-28-19	Princeton (CNFH)	04/17/1992	N/A	N/A	53,332	74	04/24/1992	06/03/1992	24	1892	0.1383	0.42		2	6	154
Sacramento-San Joaquin Estuary																
6-1-14-2-11	Ryde (FRH)	04/08/1992	64	64	53,630	77	04/11/1992	04/24/1992	78	2796	0.1387	1.38		34	0	380
6-1-14-2-10	Georgiana Sl. (FRH)	04/08/1992	56	64	51,046	74	04/14/1992	04/28/1992	23	2388	0.1387	0.42		4	10	144
6-1-14-2-12	Mossdale (FRH)		58	64	54,073	78	04/13/1992	05/06/1992	8	4588	0.1386	0.16		2803	25	45
6-1-14-2-13	Mossdale (FRH)		56	64	53,030	78	04/13/1992	05/01/1992	11	3788	0.1386	0.18		2777	46	31

Appendix 2. Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
	Total	04/07/1992			107,103		04/13/1992	05/05/1992	20	4500	0.1305		0.18			
6-1-14-2-14	Mossdale (FRH)		55	63	53,754	81	04/16/1992	04/27/1992	10	2300	0.1307	0.17		1734	37	8
6-1-14-2-15	Mossdale (FRH)		55	63	49,958	82	04/21/1992	05/01/1992	3	2180	0.1303	0.06		1851	84	12
	Total	04/13/1992			103,712		04/16/1992	05/01/1992	13	3180	0.1304		0.12			
6-1-14-3-1	Ryde (FRH)	04/14/1992	55	63	42,534	82	04/17/1992	05/07/1992	105 (1)	4180	0.1305	2.32		0	0	503
6-1-14-3-2	Georgiana Sl. (FRH)	04/14/1992	55	64	52,374	81	04/17/1992	05/08/1992	41	3900	0.1305	0.73		8	12	240
6-63-30	New Hope Landing (MOK)	04/21/1992	52	66	100,508	110	04/29/1992	05/14/1992	15	3120	0.1308	0.14		8	4	17
6-1-14-3-3	Mossdale (w/barrier) (FRH)		60	69	53,294	86	05/03/1992	05/09/1992	7	800	0.1309	0.12		24	15	28
6-1-14-3-4	Mossdale (w/barrier) (FRH)		61	69	51,445	83	05/04/1992	05/18/1992	2	3138	0.1361	0.04		4	13	15
	Total	04/24/1992			104,739		05/03/1992	05/18/1992	9	3330	0.1304		0.06			
6-31-29	Ryde (FRH)	04/27/1992	57	67	53,008	81	04/29/1992	05/20/1992	83	6063	0.1357	1.88		0	0	217
6-31-30	Georgiana Sl. (FRH)	04/27/1992	57	67	51,814	83	05/01/1992	05/10/1992	11	1940	0.1347	0.20		4	1	35
5-29-30	Benicia (CNFH)	04/28/1992	N/A	N/A	54,055	80	05/10/1992	05/10/1992	1	-	-			0	0	858
6-31-31	Mossdale (w/barrier) (FRH)		62	71	51,262	86	05/16/1992	05/16/1992	1	200	0.1300	0.02		12	0	0
6-31-32	Mossdale (w/barrier) (FRH)		62	71	48,455	83	-	-	0	-	-			18	8	0
	Total	05/04/1992			99,717		05/16/1992	05/16/1992	1	200	0.1300	0.01	0.01			
6-63-38	New Hope Landing (MOK)	05/08/1992	N/A	72	102,030	108	05/12/1992	05/18/1992	6	1500	0.1307	0.08		0	0	29
6-31-33	Mossdale (w/barrier) (FRH)		53	72	52,454	85	-	-	0	-	-			0	8	8
6-31-34	Mossdale (w/barrier) (FRH)		53	72	52,831	87	05/21/1992	05/23/1992	2	675	0.1331	0.04		0	6	3
	Total	05/12/1992			105,285		05/21/1992	05/23/1992	2	675	0.1331		0.02			

1991

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
5-1-1-1-13	Battle Creek (CNFH)	04/30/1991	N/A	N/A	64,373	78	05/11/1991	05/28/1991	14	3045	0.1300	0.21		0	0	274
5-1-1-1-12	Red Bluff (CNFH)	05/01/1991	N/A	N/A	64,118	77	05/11/1991	05/30/1991	24	3940	0.1300	0.38		0	0	378
5-18-45	Princeton (CNFH)		N/A	N/A	12,474	80	05/14/1991	05/19/1991	4	1200	0.1300	0.30		0	0	28
5-18-47	Princeton (CNFH)		N/A	N/A	18,713	80	05/11/1991	05/21/1991	10	2100	0.1302	0.80		0	0	70
5-18-48	Princeton (CNFH)		N/A	N/A	20,792	80	05/10/1991	05/30/1991	10	4100	0.1300	0.46		0	0	75
	Total	05/03/1991			51,979		05/10/1991	05/30/1991	24	4100	0.1300		0.44			

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
6-1-14-1-14	Dos Rios (FRH)		53	80	52,097	80	04/23/1991	05/11/1991	8	3700	0.1374	0.15		1282	2302	31
6-1-14-1-15	Dos Rios (FRH)		53	80	50,802	80	04/23/1991	05/02/1991	9	2000	0.1300	0.17		2302	1244	58
	Total	04/15/1991			102,899		04/23/1991	05/11/1991	17	3700	0.1374		0.16			

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS		EXPANDED OCEAN RECOVERIES
														CVP	SWP	
6-1-14-2-1	Buckley Cove (FRH)				51,128	80	04/24/1991	05/09/1991	15	2005	0.1300	0.27		272	1860	43
6-1-14-2-2	Buckley Cove (FRH)				48,213	78	04/25/1991	05/02/1991	11	1000	0.1300	0.21		66	775	72
	Total	04/16/1991	53	58	99,341		04/24/1991	05/09/1991	26	2000	0.1300		0.24			
6-1-14-2-3	Empire Tract (FRH)		54	61	48,255	79	04/24/1991	05/09/1991	25	3200	0.1300	0.48		66	782	83
6-1-14-2-4	Empire Tract (FRH)		54	61	47,347	77	04/24/1991	05/13/1991	29	3749	0.1370	0.58		74	800	72
	Total	04/17/1991			95,602		04/24/1991	05/13/1991	54	3749	0.1370		0.54			
6-1-14-2-5	L. Mokelumne River (FRH)	04/18/1991	53	61	47,283	79	04/23/1991	05/03/1991	76	2200	0.1300	1.58		0	276	141
6-1-14-2-6	Jersey Point (FRH)	04/18/1991	55	63	52,130	82	04/23/1991	05/17/1991	94	4849	0.1375	1.70		57	274	357
6-48-37	New Hope Landing (MOK)		NA	NA	8,257	100	04/29/1991	05/09/1991	4	1000	0.1300	0.45		0	0	23
6-48-38	New Hope Landing (MOK)		NA	NA	8,541	100	04/29/1991	05/06/1991	14	1400	0.1300	1.23		0	0	45
6-48-39	New Hope Landing (MOK)		NA	NA	8,891	100	04/29/1991	05/03/1991	14	1000	0.1300	1.52		0	0	51
6-48-40	New Hope Landing (MOK)		NA	NA	8,641	100	04/27/1991	05/02/1991	12	1400	0.1300	1.30		0	0	32
6-48-41	New Hope Landing (MOK)		NA	NA	8,311	100	04/29/1991	05/02/1991	14	800	0.1300	1.68		4	0	22
6-48-42	New Hope Landing (MOK)		NA	NA	7,705	100	04/29/1991	05/02/1991	17	1000	0.1300	2.07		0	48	88
6-48-43	New Hope Landing (MOK)		NA	NA	8,335	100	04/29/1991	05/02/1991	14	1000	0.1300	1.57		0	12	43
6-48-44	New Hope Landing (MOK)		NA	NA	8,814	100	04/29/1991	05/02/1991	12	1000	0.1300	1.30		0	12	18
6-48-45	New Hope Landing (MOK)		NA	NA	9,120	100	04/29/1991	05/06/1991	24	1400	0.1300	2.48		0	12	8
6-48-46	New Hope Landing (MOK)		NA	NA	8,883	100	04/29/1991	05/06/1991	14	1000	0.1300	1.51		4	28	53
	Total	04/23/1991			84,814		04/27/1991	05/09/1991	139	2000	0.1300		1.53			
6-1-14-2-7	Miller Park (FRH)		54	62	51,282	80	05/01/1991	05/09/1991	34	1200	0.1300	0.82		0	0	354
6-1-14-2-8	Miller Park (FRH)		54	62	51,272	83	04/30/1991	05/09/1991	50	2005	0.1300	0.81		0	0	275
	Total	04/25/1991			102,554		04/30/1991	05/09/1991	84	2000	0.1300		0.77			
6-1-14-2-9	Miller Park (FRH)		59	62	53,430	81	04/27/1991	05/10/1991	21	3049	0.1371	0.27		0	0	238
6-31-24	Miller Park (FRH)		58	62	51,088	78	05/04/1991	05/10/1991	34	1300	0.1340	0.64		1	0	230
	Total	04/29/1991			104,518		04/27/1991	05/10/1991	55	3049	0.1371		0.50			
6-48-57	New Hope Landing (MOK)		NA	NA	10,310	110	05/13/1991	05/21/1991	6	1000	0.1301	0.64		0	0	21
6-48-58	New Hope Landing (MOK)		NA	NA	11,886	110	05/10/1991	05/12/1991	3	749	0.1300	0.29		0	4	57
6-48-59	New Hope Landing (MOK)		NA	NA	10,588	110	05/11/1991	05/16/1991	7	1100	0.1376	0.62		0	8	13
6-48-60	New Hope Landing (MOK)		NA	NA	11,684	110	05/10/1991	05/13/1991	5	749	0.1300	0.43		0	0	4
6-48-61	New Hope Landing (MOK)		NA	NA	11,391	110	05/10/1991	05/10/1991	4	1749	0.1300	0.34		0	0	33
6-48-62	New Hope Landing (MOK)		NA	NA	11,734	110	05/10/1991	05/10/1991	8	1749	0.1350	0.80		4	0	43
6-48-63	New Hope Landing (MOK)		NA	NA	10,797	110	05/12/1991	05/10/1991	4	1300	0.1370	0.35		0	1	25
6-49-1	New Hope Landing (MOK)		NA	NA	10,813	110	05/11/1991	05/10/1991	8	1600	0.1370	0.75		0	0	7
6-49-2	New Hope Landing (MOK)		NA	NA	8,142	110	05/12/1991	05/10/1991	3	789	0.1370	0.38		0	0	12
6-49-7	New Hope Landing (MOK)		NA	NA	8,142	110	05/12/1991	05/13/1991	2	380	0.1351	0.37		0	0	0
	Total	05/08/1991			101,473		05/10/1991	05/21/1991	50	2349	0.1300		0.47			
6-31-25	Buckley Cove (FRH)		56	65	48,393	78	05/11/1991	05/20/1991	7	3049	0.1300	0.13		12	31	57
6-31-26	Buckley Cove (FRH)		56	65	50,427	85	05/11/1991	05/10/1991	13	1100	0.1370	0.24		40	33	48
	Total	05/08/1991			98,820		05/11/1991	05/20/1991	20	3049	0.1300		0.18			
6-31-27	L. Mokelumne River (FRH)	05/09/1991	59	65	45,768	84	05/12/1991	05/10/1991	31	1300	0.1370	0.64		22	13	229
5-1-1-1-4	Benicia (CNFH)	06/13/1991	NA	NA	43,750	88	-	-	0	-	-			0	0	741
6-31-28	Jersey Point (FRH)	06/13/1991	56	61	49,104	88	06/14/1991	06/23/1991	80	2000	0.1300	1.80		22	0	278

Appendix 2. Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
1999																
Fall Run Releases																
Upper Sacramento River and Tributaries (2)																
5-20-60	Battle Creek (CNFH)	05/11/1999	N/A	N/A	51,800	80	05/18/1999	06/05/1999	7	2780	0.1073	0.17		0	0	38
5-20-58	Red Bluff (CNFH)	05/12/1999	N/A	N/A	51,533	82	05/20/1999	06/02/1999	3	1000	0.0082	0.08		0	0	33
5-20-57	Princeton (CNFH)	05/14/1999	N/A	N/A	52,077	81	05/20/1999	05/22/1999	5	600	0.1300	0.09		0	0	12
Sacramento-San Joaquin Estuary																
6-1-14-1-6	Dos Reis (FRH)		55	60	53,254	73	04/20/1999	05/13/1999	2	3300	0.1273	0.04		332	566	12
6-1-14-1-7	Dos Reis (FRH)		56	60	52,488	71	05/12/19..	05/18/1999	2	600	0.1300	0.04		380	478	11
	Total	04/19/1999			105,742		04/20/1999	05/18/1999	4	3700	0.1266		0.04			
6-1-14-1-8	Upper Old River (FRH)				52,884	72	-	-	0	-	-			388	845	5
6-1-14-1-5	Upper Old River (FRH)				53,313	73	04/24/1999	05/01/1999	2	1340	0.1183	0.04		552	884	9
	Total	04/17/1999	55	70	106,297		04/24/1999	05/01/1999	2	1340	0.1183		0.02			
6-1-14-1-9	Jersey Point (FRH)	04/19/1999	56	63	52,882	71	04/21/1999	05/14/1999	32	4400	0.1290	0.81		30	126	223
6-1-14-1-10	Dos Reis (FRH)		60	60	52,860	74	05/13/1999	05/10/1999	3	600	0.1300	0.05		18	34	8
6-1-14-1-11	Dos Reis (FRH)		60	60	50,674	75	05/10/1999	05/10/1999	1	200	0.1300	0.02		38	62	26
	Total	05/02/1999			103,533		05/13/1999	05/10/1999	4	800	0.1300		0.04			
6-1-14-1-12	Upper Old River (FRH)		54	72	51,821	76	05/10/1999	05/10/1999	1	200	0.1300	0.02		224	477	5
6-1-14-1-13	Upper Old River (FRH)		54	72	52,074	76	-	-	0	-	-			202	443	6
	Total	05/03/1999			103,895		05/10/1999	05/10/1999	1	200	0.1300		0.01			
6-31-19	Jersey Point (3) (FRH)	05/04/1999	59	60	50,143	77	05/05/1999	05/29/1999	85	3000	0.1271	1.14		14	48	207
6-31-18	Sacramento (3) (FRH)	05/07/1999	59	70	48,390	74	05/11/1999	06/01/1999	44	3520	0.1111	1.08		8	0	115
6-31-20	Ryde (3) (FRH)	05/08/1999	54	60	51,879	79	05/12/1999	05/20/1999	80	2720	0.1040	2.13		6	0	174
5-20-63	Benicia (CNFH)	05/22/1999	N/A	N/A	52,448	82	-	-	0	-	-			0	0	244
6-31-23	Sutter Slough (FRH)	05/29/1999	50	63	48,324	83	06/01/1999	06/14/1999	30	2780	0.1309	0.75		0	0	222
6-31-21	Steamboat Slough (FRH)	05/30/1999	51	63	52,818	86	06/01/1999	06/12/1999	58	2300	0.1377	1.06		0	8	318
6-31-22	Ryde (FRH)	05/31/1999	51	65	50,837	84	06/02/1999	06/11/1999	67	1080	0.1375	1.26		0	0	217
Upper San Joaquin River and Tributaries																
6-1-11-1-14	Upper Tuolumne (MRFF)		59	52	24,134	83	05/12/1999	05/12/1999	1	200	0.1300	0.04		152	253	12
6-1-11-1-15	Upper Tuolumne (MRFF)		58	52	24,250	83	05/10/1999	05/10/1999	1	270	0.1300	0.04		94	231	5
6-1-11-2-1	Upper Tuolumne (MRFF)		59	52	23,494	83	05/12/1999	05/12/1999	1	200	0.1300	0.04		134	244	0
6-1-11-2-2	Upper Tuolumne (MRFF)		58	52	21,788	83	05/09/1999	05/09/1999	1	200	0.1300	0.04		80	150	0

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Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
	Total	04/30/1988			83,653		05/08/1988	05/16/1988	4	1740	0.1343		0.04			
6-1-11-2-3	Lower Tuolumne (TRFF)		48	66	27,283	72	05/12/1988	05/12/1988	1	200	0.1389	0.03		122	296	1
6-1-11-2-4	Lower Tuolumne (TRFF)		55	66	26,087	72	-	-	0	-	-			92	183	17
6-1-11-2-5	Lower Tuolumne (TRFF)		48	66	24,865	72	-	-	0	-	-			102	14	0
	Total	05/01/1988			78,235		05/12/1988	05/12/1988	1	200	0.1389		0.01			

1989

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
5-29-37	Battle Creek (CNFH)	05/08/1989	N/A	N/A	51,074	80	05/16/1989	06/07/1989	13	4178	0.1281	0.26		6	0	84
5-30-38	Red Bluff (CNFH)	05/09/1989	N/A	N/A	52,677	70	05/16/1989	06/09/1989	18	4378	0.1287	0.35		0	0	91
5-29-39	Princeton (CNFH)	05/10/1989	N/A	N/A	50,042	72	05/11/1989	05/31/1989	27	3800	0.1287	0.55		12	0	90

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
6-31-14	Dos Reis (FRH)	04/20/1989	54	60	52,662	85	04/27/1989	05/07/1989	8	2200	0.1380	0.14		428	2298	34
6-31-13	Upper Old River (FRH)	04/21/1989	54	67	51,872	81	04/25/1989	05/04/1989	5	2000	0.1380	0.09		658	2918	38
6-1-11-1-11	Jersey Point (FRH)		50	64	27,758	70	04/29/1989	05/10/1989	24	3300	0.1385	0.81		0	80	83
6-1-11-1-12	Jersey Point (FRH)		50	64	28,058	70	04/29/1989	05/12/1989	29	2700	0.1384	0.94		12	42	99
	Total	04/24/1989			55,816		04/29/1989	05/10/1989	53	3300	0.1385		0.88			
6-1-11-1-7	Dos Reis (MRFF)		62	71	25,089	70	05/10/1989	05/30/1989	3	3800	0.1257	0.12		12	100	29
6-1-11-1-8	Dos Reis (MRFF)		62	71	25,631	70	05/08/1989	05/24/1989	7	3380	0.1306	0.28		36	78	32
6-1-11-1-13	Dos Reis (MRFF)		62	71	25,353	70	05/10/1989	05/10/1989	1	200	0.1380	0.04		36	108	18
	Total	05/02/1989			76,073		05/08/1989	05/30/1989	11	4180	0.1288		0.15			
6-31-11	Courtland (FRH)	05/02/1989	56	61	51,211	87	05/05/1989	05/10/1989	46	2380	0.1363	0.84		0	26	247
6-1-11-1-4	Upper Old River (MRFF)		62	70	25,087	70	05/08/1989	05/08/1989	1	200	0.1380	0.04		428	74	5
6-1-11-1-5	Upper Old River (MRFF)		62	70	24,472	70	05/08/1989	05/08/1989	1	100	0.1319	0.04		524	22	0
6-1-11-1-6	Upper Old River (MRFF)		62	70	24,782	70	05/08/1989	05/15/1989	2	1800	0.1380	0.08		107	294	11
	Total	05/03/1989			74,341		05/08/1989	05/15/1989	4	1800	0.1380		0.05			
6-31-12	Ryde (FRH)	05/03/1989	54	62	51,048	88	05/08/1989	05/15/1989	65	1888	0.1382	1.20		0	18	417
6-1-11-1-9	Jersey Point (FRH)		54	68	27,525	73	05/08/1989	05/26/1989	33	3040	0.1385	1.13		0	508	144
6-1-11-1-10	Jersey Point (FRH)		54	68	28,708	73	05/08/1989	05/22/1989	25	2980	0.1384	0.82		12	304	141
	Total	05/05/1989			56,233		05/08/1989	05/26/1989	58	3080	0.1386		0.97			
5-29-40	Benicia (CNFH)	05/16/1989	N/A	N/A	30,379	72	-	-	0	-	-			0	0	186
6-31-10	Miller Park (FRH)	06/01/1989	51	67	52,012	88	06/05/1989	06/09/1989	14	800	0.1380	0.25		0	0	81
6-31-8	Courtland (FRH)	06/02/1989	58	60	50,080	92	06/05/1989	06/08/1989	18	1000	0.1388	0.35		0	0	42
6-31-7	Ryde (FRH)	06/02/1989	56	67	50,801	88	06/06/1989	06/14/1989	26	2000	0.1389	0.48		0	0	42

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
6-31-9	Port Chicago (FRH)	06/06/1988	50	67	45,446 (5)	90	06/08/1988	06/17/1988	40	-	-			0	0	180
6-31-15	Miller Park (FRH)		56	70	44,895	84	06/17/1988	06/19/1988	11	600	0.1300	0.23		0	0	33
6-31-17	Miller Park (FRH)		56	70	49,909	83	06/17/1988	06/19/1988	9	600	0.1300	0.17		0	0	35
	Total	06/14/1988			94,804		06/17/1988	06/19/1988	20	600	0.1300		0.20			
6-1-14-1-3	Courtland (west) (FRH)		60	71	52,907	86	06/17/1988	06/21/1988	17	1000	0.1300	0.30		0	0	47
6-90-6	Courtland (east) (FRH)		57	71	37,813	90	06/16/1988	06/22/1988	4	1000	0.1300	0.10		0	0	37
	Total	06/15/1988			90,720	88	06/17/1988	06/22/1988	21	1200	0.1300		0.22			
6-1-14-1-1	Steamboat Sl. (FRH)	06/13/1988	55	70	51,237	79	06/15/1988	06/22/1988	50	1600	0.1300	0.91		0	0	70
6-31-16	Sutter Slough (FRH)	06/13/1988	57	68	49,762	83	06/15/1988	06/29/1988	57	2875	0.1331	1.12		0	0	152
6-1-14-1-2	Ryde (FRH)	06/16/1988	56	73	51,134	85	06/19/1988	06/29/1988	8	1400	0.1288	0.16		0	0	10
6-1-14-1-4	Port Chicago (FRH)	06/16/1988	54	71	48,320	88	06/20/1988	06/22/1988	30	-	-			0	0	353
	Upper San Joaquin River and Tributaries															
B6-14-9	Upper Stanislaus (MRFF)		58	64	52,445	78	04/29/1988	05/11/1988	3	2500	0.1304	0.05		416	1325	17
B6-14-10	Upper Stanislaus (MRFF)		60	64	51,506	78	04/29/1988	05/10/1988	4	3300	0.1306	0.07		408	1080	17
	Total	04/26/1988			103,951		04/29/1988	05/10/1988	7	3500	0.1305		0.06			
B6-1-1	Lower Stanislaus (MRFF)		60	66	25,525	78	04/24/1988	05/02/1988	11	1000	0.1300	0.40		200	1152	24
B6-14-11	Lower Stanislaus (MRFF)		60	66	48,695	76	04/24/1988	04/27/1988	6	800	0.1300	0.12		480	1754	35
	Total	04/19/1988			74,220		04/24/1988	05/02/1988	17	1000	0.1300		0.21			
6-1-11-1-1	Lower Merced (MRFF)		58	70	25,357	88	05/03/1988	05/10/1988	3	1000	0.1300	0.11		238	480	3
6-1-11-1-2	Lower Merced (MRFF)		58	70	25,276	86	05/16/1988	05/16/1988	1	200	0.1300	0.04		307	324	2
6-1-11-1-3	Lower Merced (MRFF)		58	70	23,832	88	-	-	0	-	-			192	209	0
	Total	04/21/1988			74,465		05/03/1988	05/16/1988	4	2000	0.1304		0.06			
B6-14-12	Lower Stanislaus (MRFF)	05/03/1988	60	66	46,189	72	-	-	0	-	-			880	400	12
1989																
Fall Run																
	Upper Sacramento River and Tributaries															
5-19-39	Battle Creek (CNFH)	06/08/1989	N/A	N/A	51,823	84	06/10/1989	06/29/1989	46	6315	0.2741	0.41		0	0	383
5-19-40	Red Bluff (CNFH)	06/10/1989	N/A	N/A	52,798	84	06/10/1989	06/29/1989	37	6315	0.2741	0.33		0	0	408
5-19-41	Princeton (CNFH)	06/11/1989	N/A	N/A	52,771	85	06/13/1989	06/28/1989	43	4315	0.2724	0.39		0	0	413
	Sacramento-San Joaquin Estuary															
B6-14-2	Courtland (FRH)				51,388		06/07/1989	06/21/1989	71	6990	0.2773	0.85		42	508	558
B6-14-3	Courtland (FRH)				55,861		06/07/1989	06/29/1989	83	7515	0.2747	0.79		43	484	631
	Total	06/03/1989	60	62	107,249	78	06/07/1989	06/29/1989	154	7515	0.2747		0.80			

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
6-31-1	Ryde (FRH)	05/04/1988	61	63	52,741	86	05/06/1988	05/17/1988	105	4820	0.2788	0.93		0	0	1074
B6-14-6	Miller Park (FRH)				51,005		05/06/1988	05/23/1988	77	6330	0.2747	0.71		0	210	574
B6-14-7	Miller Park (FRH)				51,731		05/06/1988	05/21/1988	65	5180	0.2772	0.59		4	266	543
	Total	05/05/1988	54	62	102,736	78	05/06/1988	05/23/1988	142	6330	0.2747		0.65			
B6-14-4	Courtland (FRH)		49		51,274		05/09/1988	05/27/1988	67	7310	0.2538	0.67		0	220	414
B6-14-5	Courtland (FRH)		51		51,206		05/10/1988	05/21/1988	80	4780	0.2772	0.73		28	204	521
	Total	05/09/1988		61	102,480	78	05/09/1988	05/27/1988	147	7310	0.2538		0.73			
6-31-2	Ryde (FRH)	05/09/1988	52	61	53,230	80	05/09/1988	05/18/1988	145 (8)	4400	0.2778	1.27		0	0	1324
B6-14-8	Port Chicago (FRH)	05/11/1988	54	70	55,265	84	-	-	0	-	-			0	0	1118
6-18-42	Benicia (CNFH)	05/17/1988	N/A	N/A	51,651	88	-	-	0	-	-			0	0	328
6-62-58	Courtland (FRH)		51	73	54,097	87	06/23/1988	06/29/1988	25	2800	0.2778	0.21		0	0	551
6-62-60	Courtland (FRH)		51	73	51,904	87	06/23/1988	07/03/1988	14	4400	0.2778	0.13		0	0	488
	Total	06/21/1988			106,001		06/23/1988	07/03/1988	39	4400	0.2778		0.17			
6-62-63	Ryde (FRH)	06/22/1988	61	75	53,661	84	06/23/1988	07/04/1988	46	4800	0.2778	0.40		0	0	250
6-62-61	Miller Park (FRH)		56	74	49,245	89	06/26/1988	07/07/1988	7 (7)	3960	0.2282	0.08		0	0	79
6-62-62	Miller Park (FRH)		56	74	48,647	89	06/26/1988	07/03/1988	7 (7)	3200	0.2778	0.07		0	0	63
	Total	06/23/1988			97,892		06/26/1988	07/07/1988	14	3960	0.2282		0.08			
6-62-59	Courtland (FRH)	06/24/1988	53	76	98,827	74	06/26/1988	07/03/1988	5	2400	0.2778	0.02		0	0	71
6-31-5	Steamboat Slough (FRH)		55	76	49,342	88	06/26/1988	07/03/1988	38	3200	0.2778	0.37		0	0	183
6-31-6	Steamboat Slough (FRH)		55	76	47,975	89	06/25/1988	07/01/1988	40	2800	0.2778	0.38		0	0	207
	Total	06/24/1988			97,317		06/25/1988	07/03/1988	78	3600	0.2778		0.38			
6-31-3	Ryde (FRH)	06/28/1988	50	74	53,942	88	06/28/1988	07/01/1988	38	2400	0.2778	0.34		0	0	286
6-31-4	Port Chicago (FRH)	06/29/1988	49	76	54,151	91	-	-	0	-	-			0	0	1032
Upper San Joaquin River and Tributaries																
B6-11-5	Upper Stanislaus (MRFF)		60	55	36,769	78	05/04/1988	05/11/1988	6	3220	0.2795	0.08		874	2188	35
B6-11-6	Upper Stanislaus (MRFF)		60	56	34,906	78	05/12/1988	05/21/1988	5	3990	0.2771	0.07		838	1852	63
	Total	04/26/1988			71,675		05/04/1988	05/21/1988	11	7210	0.2782		0.07			
B6-11-3	Lower Stanislaus (MRFF)		62	66	36,249	79	05/03/1988	05/18/1988	6	8820	0.2704	0.08		2906	2118	158
B6-11-4	Lower Stanislaus (MRFF)		62	66	33,539	79	05/07/1988	05/22/1988	7	6330	0.2747	0.10		3072	2303	112
	Total	04/28/1988			69,788		05/03/1988	05/22/1988	13	7750	0.2881		0.09			
1987																
Fall Run Releases																
Upper Sacramento River and Tributaries																
H6-7-7	Below RBDD (CNFH)	03/13/1987	N/A	N/A	52,977	52	04/27/1987	05/11/1987	4	3015	0.1306	0.07		0	1*	113

Appendix 3: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
B6-4-13	Battle Creek (CNFH)	03/12/1997	N/A	N/A	51,675	51	04/21/1997	04/30/1997	5	1985	0.1306	0.08		1*	0	182
5-10-39	Battle Creek (CNFH)	05/12/1997	N/A	N/A	51,706	84	05/18/1997	05/21/1997	10	780	0.1372	0.18		0	0	450
5-10-40	Red Bluff (CNFH)	05/13/1997	N/A	N/A	51,807	84	05/19/1997	05/22/1997	6	790	0.1372	0.11		0	0	367
5-10-41	Princeton (CNFH)	05/14/1997	N/A	N/A	51,271	84	05/19/1997	05/19/1997	1	180	0.1319	0.02		0	0	178
Sacramento-San Joaquin Estuary																
H6-7-8	Courtland (CNFH)	03/03/1997	N/A	N/A	46,733	80	04/20/1997	04/30/1997	1	300	0.1300	0.02		4*	3*	28
6-46-3	Upper Old River (MRFF)		60	72	31,088	79	04/30/1997	05/08/1997	8	1436	0.1424	0.23		6177	2149	171
6-46-4	Upper Old River (MRFF)		60	73	29,253	79	04/30/1997	05/08/1997	5	1236	0.1429	0.16		5188	2153	149
6-46-5	Upper Old River (MRFF)		60	73	30,008	79	04/30/1997	05/07/1997	3	845	0.1467	0.08		6277	2105	179
	Total	04/27/1997			90,352		04/30/1997	05/08/1997	16	1436	0.1424		0.16			
6-46-6	Dos Reis (MRFF)		56	70	30,919	80	05/08/1997	05/13/1997	30	1795	0.1362	0.83		524	1421	370
6-46-7	Dos Reis (MRFF)		56	70	31,634	80	05/08/1997	05/20/1997	22	3135	0.1301	0.66		472	1451	436
6-46-8	Dos Reis (MRFF)		56	70	30,069	80	05/08/1997	05/13/1997	26	1886	0.1380	0.80		532	1808	408
	Total	04/27/1997			92,612		05/08/1997	05/20/1997	88	3135	0.1301		0.83			
6-62-53	Courtland (FRH)		57	67	49,781	81	05/01/1997	05/13/1997	32	2410	0.1385	0.85		27	26	606
6-62-54	Courtland (FRH)		56	67	50,521	81	05/01/1997	05/14/1997	39	2810	0.1304	0.72		13	114	687
	Total	04/28/1997			100,302		05/01/1997	05/14/1997	71	2810	0.1304		0.86			
6-62-55	Ryde (FRH)	04/28/1997	60	67	51,183	79	05/02/1997	05/12/1997	46	2210	0.1385	0.84		0	0	1612
6-62-56	Courtland (FRH)		57	67	49,083	79	05/04/1997	05/16/1997	20	2385	0.1380	0.38		0	0	739
6-62-57	Courtland (FRH)		56	67	51,835	79	05/06/1997	05/22/1997	23	3635	0.1384	0.42		7	180	685
	Total	05/01/1997			100,918		05/04/1997	05/22/1997	43	3735	0.1385		0.41			
6-62-58	Ryde (FRH)	05/03/1997	53	64	51,000	80	05/05/1997	05/15/1997	47	2105	0.1387	0.80		0	0	1038
Upper San Joaquin River and Tributaries																
6-46-60	Upper Tuolumne (MRFF)		50	55	29,860	85	04/25/1997	05/01/1997	2	1300	0.1304	0.08		520	99	33
6-46-61	Upper Tuolumne (MRFF)		50	55	30,001	85	-	-	0	-	-			574	132	31
6-46-62	Upper Tuolumne (MRFF)		50	55	29,048	85	04/28/1997	04/30/1997	3	886	0.1377	0.10		550	110	27
	Total	04/18/1997			88,909		04/25/1997	05/01/1997	5	1300	0.1304		0.05			
6-45-1	Lower Tuolumne (MRFF)		50	64	31,963	82	04/23/1997	05/04/1997	6	2646	0.1410	0.14		738	1810	141
6-45-2	Lower Tuolumne (MRFF)		50	64	30,838	82	04/23/1997	05/08/1997	9	2620	0.1404	0.27		834	1702	87
6-46-63	Lower Tuolumne (MRFF)		50	64	30,709	82	04/28/1997	05/08/1997	4	2626	0.1410	0.12		888	1451	143
	Total	04/18/1997			93,511		04/23/1997	05/08/1997	19	2630	0.1404		0.18			

1998

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
H6-7-5	Below RBDD (CNFH)	03/18/1998	N/A	N/A	51,420	80	04/25/1998	05/08/1998	7	1700	0.0883	0.30		0	0	429

98

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
H5-7-7	Battle Creek (CNFH)	03/18/1988	N/A	N/A	51,371	80	04/29/1988	05/17/1988	8	3157	0.1184	0.18		0	0	221
H5-4-2	Battle Creek (CNFH)		N/A	67	24,833	88	05/21/1988	05/30/1988	11	1200	0.1200	0.41		0	0	334
H5-4-3	Battle Creek (CNFH)		N/A	67	28,869	88	05/21/1988	05/27/1988	19	1400	0.1300	0.62		0	0	313
	Total	05/13/1988			53,882		05/21/1988	05/27/1988	30	1400	0.1300		0.52			
H5-4-4	Below RBDD (CNFH)		N/A	58	26,906	87	05/21/1988	05/31/1988	8	2200	0.1300	0.31		0	0	385
H5-4-5	Below RBDD (CNFH)		N/A	60	27,605	87	05/20/1988	06/01/1988	17	2000	0.1300	0.56		0	0	442
	Total	05/13/1988			54,506		05/20/1988	06/01/1988	25	2000	0.1300		0.45			
H5-4-6	Princeton (CNFH)		N/A	62	23,088	88	05/23/1988	05/27/1988	3	1000	0.1200	0.12		0	0	506
H5-4-7	Princeton (CNFH)		N/A	62	22,718	88	05/19/1988	05/22/1988	7	800	0.1200	0.29		0	0	421
	Total	05/14/1988			45,806		05/19/1988	05/27/1988	10	1800	0.1200		0.17			
Sacramento-San Joaquin Estuary																
H8-6-7	Courtland (CNFH)	03/27/1988	N/A	N/A	50,881	45	04/18/1988	04/18/1988	1	180	0.1111	0.02		0	0	22
H8-7-3	Courtland (CNFH)	03/10/1988	N/A	N/A	53,821	50	04/17/1988	04/17/1988	2	160	0.1250	0.04		0	0	65
	Total				104,702		04/17/1988	04/18/1988	3	340	0.0787		0.05			
H8-7-2	Ryde (CNFH)	03/14/1988	N/A	N/A	52,636	47	-	-	0	-	-			0	0	83
H8-7-4	Ryde (CNFH)	03/12/1988	N/A	N/A	52,746	53	-	-	0	-	-			0	0	127
	Total				105,383											
6-62-43	Courtland (FRH)	05/27/1988	N/A	73	98,886	81	05/31/1988	06/10/1988	38	2100	0.1300	0.37		0	0	1082
6-62-46	South Fork Mok. (FRH)	05/18/1988	52	68	102,888	77	06/01/1988	06/10/1988	24	2070	0.1140	0.26		300	12	884
6-62-47	North Fork Mok. (FRH)	05/20/1988	60	72	101,948	74	06/03/1988	06/10/1988	33	2770	0.1125	0.37		0	0	1306
6-46-58	Dos Reis (MRFH)		N/A	68	47,984	88	06/02/1988	06/09/1988	13	1300	0.1307	0.25		280	280	1063
B6-11-1	Dos Reis (MRFH)		N/A	68	47,841	88	06/02/1988	06/07/1988	22	1100	0.1307	0.43		254	244	1015
	Total	05/29/1988			95,825		06/02/1988	06/09/1988	35	1300	0.1307		0.34			
6-62-48	Ryde (FRH)	05/30/1988	58	74	101,320	81	06/01/1988	06/13/1988	74	2000	0.1300	0.68		0	0	1979
6-46-60	Upper Old River (MRFF)		N/A	79	49,434	88	06/01/1988	06/03/1988	10	1100	0.1307	0.19		3072	1080	588
B6-11-2	Upper Old River (MRFF)		N/A	79	50,747	88	06/01/1988	06/03/1988	11	800	0.1300	0.20		2616	1426	554
	Total	05/30/1988			100,181		06/01/1988	06/03/1988	21	1100	0.1307		0.20			
6-62-49	Lower Old River (FRH)	05/31/1988	60	74	99,888	78	06/02/1988	06/08/1988	26	1300	0.1307	0.24		3182	2080	845
6-62-51	Port Chicago (FRH)	06/02/1988	60	62	47,888	76	06/08/1988	06/10/1988	4	-	-			0	0	1382
Upper San Joaquin River and Tributaries																
6-46-64	Upper Tuolumne (MRFF)		N/A	51	48,630	81	04/25/1988	05/27/1988	17	5567	0.1188	0.38		1406	1187	888
6-46-65	Upper Tuolumne (MRFF)		N/A	51	49,518	81	04/23/1988	05/21/1988	18	4867	0.1001	0.43		1806	2125	848
	Total	04/14/1988			98,148		04/23/1988	05/27/1988	35	8757	0.1142		0.40			
6-46-66	Lower Tuolumne (MRFF)		N/A	51	51,300	80	04/23/1988	06/07/1988	10	1700	0.0924	0.31		1862	1247	862
6-46-67	Lower Tuolumne (MRFF)		N/A	51	52,174	80	04/25/1988	05/10/1988	10	2100	0.0948	0.28		1512	1308	1088

Appendix 2 Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
	Total	[illegible]			103,47[illegible]		[illegible]	[illegible]	20	2380	0.0918		0.27			
6-46-45	Upper Stanislaus (MRFF)		N/A	52	31,120	80	[illegible]	[illegible]	17	6375	0.1292	0.55		1018	370	393
6-46-49	Upper Stanislaus (MRFF)		N/A	52	31,148	80	[illegible]	[illegible]	11	3177	0.1379	0.33		1144	304	433
6-46-50	Upper Stanislaus (MRFF)		N/A	52	24,731	80	[illegible]	[illegible]	4	6375	0.1353	0.15		744	434	343
6-46-53	Upper Stanislaus (MRFF)		N/A	52	21,234	80	[illegible]	[illegible]	5	6975	0.1294	0.22		612	262	260
	Total	[illegible]			108,273		[illegible]	[illegible]	37	6375	0.1292		0.34			
6-46-43	Lower Stanislaus (MRFF)		N/A	60	31,401	80	[illegible]	[illegible]	16	2197	0.1307	0.46		1365	1224	891
6-46-46	Lower Stanislaus (MRFF)		N/A	59	31,310	80	[illegible]	[illegible]	18	4177	0.1301	0.84		1378	948	815
6-46-47	Lower Stanislaus (MRFF)		N/A	58	28,520	80	[illegible]	[illegible]	20	2977	0.1292	0.66		1162	1509	872
6-46-52	Lower Stanislaus (MRFF)		N/A	60	12,700	80	[illegible]	[illegible]	6	2777	0.1377	0.44		880	844	308
	Total	[illegible]			103,100		[illegible]	[illegible]	60	4377	0.1322		0.60			

1986

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
HS-3-7	Battle Creek (CNFH)		N/A	N/A	28,128	47	-	-	0	-	-			0	0	13
HS-4-1	Battle Creek (CNFH)		N/A	N/A	23,848	47	-	-	0	-	-			0	0	10
	Total	[illegible]														
HS-6-6	Below RBDD (CNFH)	[illegible]	N/A	N/A	48,185	47	-	-	0	-	-			0	0	74
HS-6-5	Below RBDD (CNFH)	[illegible]	N/A	N/A	82,313	48	-	-	0	-	-			0	0	188
	Total															
5-39-4	Battle Creek (CNFH)		N/A	N/A	11,404	80	[illegible]	[illegible]	2	800	0.1300	0.18		0	0	0
5-40-4	Battle Creek (CNFH)		N/A	N/A	18,883	82	[illegible]	[illegible]	2	800	0.1300	0.17		0	0	21
5-41-4	Battle Creek (CNFH)		N/A	N/A	10,338	80	[illegible]	[illegible]	3	800	0.1300	0.27		0	0	8
HS-1-5	Battle Creek (CNFH)		N/A	N/A	22,[illegible]	80	[illegible]	[illegible]	3	800	0.1300	0.12		0	0	32
5-6-16	Battle Creek (CNFH)		N/A	N/A	17,388	80	[illegible]	[illegible]	1	200	0.1300	0.00		0	0	0
	Total	[illegible]			[illegible],279		[illegible]	[illegible]	11	1300	0.1300		0.16			
5-6-47	Below RBDD (CNFH)		N/A	N/A	21,[illegible]	82	[illegible]	[illegible]	2	800	0.1300	0.08		0	0	30
5-42-4	Below RBDD (CNFH)		N/A	N/A	18,[illegible]	82	[illegible]	[illegible]	5	2200	0.1300	0.44		0	0	47
5-43-4	Below RBDD (CNFH)		N/A	N/A	8,[illegible]	82	[illegible]	[illegible]	3	400	0.1300	0.29		0	0	20
HS-1-9	Below RBDD (CNFH)		N/A	N/A	23,370	82	[illegible]	[illegible]	9	930	0.1300	0.36		0	0	27
	Total	[illegible]			86,815		[illegible]	[illegible]	10	2200	0.1300		0.27			
5-6-43	Princeton (CNFH)		N/A	N/A	21,943	82	[illegible]	[illegible]	3	900	0.1300	0.13		0	0	60
5-6-48	Princeton (CNFH)		N/A	N/A	20,480	82	[illegible]	[illegible]	3	400	0.1300	0.14		0	0	68
HS-1-7	Princeton (CNFH)		N/A	N/A	23,819	82	[illegible]	[illegible]	3	800	0.1300	0.12		0	0	34
	Total	[illegible]			66,622		[illegible]	[illegible]	9	1000	0.1300		0.13			

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
HS-8-8	Courtland (CNFH)	[illegible]	N/A	N/A	51,281	48	-	-	0	-	-			0	0	153
HS-8-4	Courtland (CNFH)	[illegible]	N/A	N/A	51,888	48	-	-	0	-	-			0	0	88
	Total				103,168											
HS-6-1	South Fork Mok. (CNFH)	[illegible]	N/A	N/A	50,052	48	-	-	0	-	-					88
HS-6-2	North Fork Mok. (CNFH)	[illegible]	N/A	N/A	51,145	48	-	-	0	-	-			0	0	78

Appendix 2 Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
					101,197									0	0	
H8-5-7	Ryde (CNFH)	03/21/1995	N/A	N/A	49,183	47	-	-	0	-	-			0	0	83
H8-6-3	Ryde (CNFH)	03/06/1995	N/A	N/A	50,550	47	-	-	0	-	-			0	0	88
	Total				99,733											
6-62-42	Lower Old River (FRH)	05/09/1995	54	60	105,300	84	05/11/1995	05/25/1995	20	3000	0.1300	0.18		5136	8638	232
6-62-34	South Fork Mok. (FRH)	05/07/1995	48	64	108,308	75	05/14/1995	05/27/1995	25	2800	0.1300	0.23		80	0	317
6-62-30	North Fork Mok. (FRH)	05/08/1995	54	60	101,238	77	05/14/1995	05/27/1995	30	2800	0.1300	0.29		10	4	858
6-62-38	Courtland (FRH)		60	64	54,457	78	05/14/1995	05/20/1995	23	2400	0.1300	0.40		0	0	230
6-62-39	Courtland (FRH)		60	64	14,731	78	05/14/1995	05/20/1995	2	2400	0.1300	0.13		0	0	24
6-62-40	Courtland (FRH)		60	64	10,557	78	05/14/1995	05/20/1995	3	2400	0.1300	0.28		0	0	48
6-62-41	Courtland (FRH)		60	64	20,881	78	05/14/1995	05/20/1995	9	2400	0.1400	0.41		0	0	83
	Total	05/10/1995			100,626		05/14/1995	05/20/1995	37	2400	0.1300		0.34			
6-62-36	Ryde (FRH)	05/11/1995	51	60	107,181	78	05/14/1995	05/25/1995	60	2400	0.1300	0.77		0	0	826
6-62-48	Port Chicago (FRH)	05/13/1995	58	66	49,143	76	05/14/1995	05/27/1995	0	-	-			0	0	403

1994

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
H8-4-4	Below RBDD (CNFH)	03/01/1994	N/A	N/A	43,883	45	-	-	0	-	-			1*	0	124
H8-5-4	Below RBDD (CNFH)	03/24/1994	N/A	N/A	47,880	80	-	-	0	-	-			0	0	234
	Total															
6-60-42	Battle Creek (CNFH)		N/A	N/A	59,742	80	05/10/1994	05/23/1994	10	730	0.0834	0.77		0	0	820
6-60-43	Battle Creek (CNFH)		N/A	N/A	48,479	80	05/10/1994	05/23/1994	16	730	0.0834	0.89		0	0	898
	Total	05/09/1994			108,221		05/10/1994	05/23/1994	26	730	0.0834		0.72			
6-60-40	Below RBDD (CNFH)		N/A	N/A	51,848	80	05/10/1994	05/23/1994	20	880	0.0887	1.08		0	0	1055
6-60-41	Below RBDD (CNFH)		N/A	N/A	50,821	80	05/10/1994	05/23/1994	25	880	0.0887	1.05		0	0	1181
	Total	05/08/1994			102,669		05/10/1994	05/23/1994	50	880	0.0887		1.07			
6-60-38	Knights Landing (CNFH)		N/A	N/A	48,400	80	05/13/1994	05/22/1994	19	930	0.0887	0.88		0	0	953
6-60-39	Knights Landing (CNFH)		N/A	N/A	40,351	85	05/10/1994	05/23/1994	17	880	0.0887	0.88		0	0	1062
	Total	05/09/1994			88,751		05/13/1994	05/23/1994	36	930	0.0887		0.81			

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
H8-4-5	Courtland (CNFH)	03/08/1994	N/A	N/A	48,460	45	-	-	0	-	-			0	0	87
H8-6-3	Courtland (CNFH)	03/21/1994	N/A	N/A	48,157	48	-	-	0	-	-			0	0	179
	Total				96,617											
H8-4-6	Ryde (CNFH)	03/08/1994	N/A	N/A	48,485	48	-	-	0	-	-			4*	0	82
H8-6-2	Ryde (CNFH)	03/18/1994	N/A	N/A	48,787	48	-	-	0	-	-			4*	0	142
	Total															

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Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
H6-5-1	South Fork Mok. (CNFH)	03/14/1984	N/A	N/A	45,038	49	-	-	0	-	-			3*	0	38
H6-4-7	North Fork Mok. (CNFH)	03/12/1984	N/A	N/A	42,165	50	-	-	0	-	-			5*	0	61
6-62-27	Courtland (FRH)	06/11/1984	54	66	62,604	82	06/14/1984	06/28/1984	37	2380	0.1083	0.70		0	0	390
6-62-28	South Fork Mok. (FRH)		64	67	41,371	77	06/16/1984	06/28/1984	25	1720	0.1088	0.72		0	0	288
6-42-8	South Fork Mok. (FRH)		64	67	14,816	77	06/17/1984	06/22/1984	9	1820	0.1181	0.66		0	0	82
	Total	06/12/1984			56,287		06/16/1984	06/28/1984	34	1720	0.1088		0.72			
6-62-29	Ryde (FRH)		66	66	44,818	77	06/18/1984	06/28/1984	30	2100	0.1328	0.86		0	0	195
6-42-9	Ryde (FRH)		58	66	15,180	77	06/17/1984	06/28/1984	8	1800	0.1190	0.82		0	0	73
	Total	06/13/1984			59,998		06/16/1984	06/28/1984	38	2100	0.1122		0.73			
6-62-32	North Fork Mok. (FRH)	06/14/1984	66	67	58,806	79	06/16/1984	07/03/1984	24	2140	0.0833	3.56		0	0	286
6-62-33	Lower Old River (FRH)	06/18/1984	68	75	64,888	73	06/20/1984	06/27/1984	9	1300	0.1130	0.18		48	0	40
6-48-22	Thornton (FRH)		N/A	N/A	47,880	77	06/27/1984	06/29/1984	8	880	0.1343	0.12		0	0	45
6-48-23	Thornton (FRH)		N/A	N/A	47,880	77	06/28/1984	06/30/1984	10	940	0.1308	0.21		0	0	34
	Total	06/22/1984			95,000		06/28/1984	06/30/1984	18	940	0.1308		0.17			
6-62-31	Port Chicago (FRH)		59	72	18,442	88	06/29/1984	06/30/1984	9	-	-			0	0	93
6-62-37	Port Chicago (FRH)		59	72	23,588	88	06/30/1984	07/03/1984	21	-	-			0	0	223
	Total	06/29/1984			42,030		06/30/1984	07/03/1984	30							

1983

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
6-60-36	Battle Creek (CNFH)		N/A	N/A	44,282	77	06/07/1983	06/24/1983	15	1753	0.0876	0.66		0	0	86
6-60-37	Battle Creek (CNFH)		N/A	N/A	43,808	76	06/07/1983	06/17/1983	10	1373	0.0867	0.34		0	0	97
	Total	06/02/1983			87,090		06/07/1983	06/24/1983	25	1753	0.0876		0.55			
6-60-34	Below RBDD (CNFH)		N/A	N/A	44,498	76	06/07/1983	06/18/1983	16	1183	0.0821	0.61		0	0	22
6-60-35	Below RBDD (CNFH)		N/A	N/A	45,343	75	06/07/1983	06/21/1983	10	1863	0.0718	0.40		0	0	72
	Total	06/02/1983			89,841		06/07/1983	06/21/1983	26	1863	0.0718		0.52			
6-60-32	Knights Landing (CNFH)		N/A	N/A	45,988	75	06/06/1983	06/10/1983	45	1883	0.1008	1.28		0	0	72
6-60-33	Knights Landing (CNFH)		N/A	N/A	46,088	74	06/06/1983	06/21/1983	31	1863	0.0788	1.10		0	0	56
	Total	06/02/1983			92,085		06/06/1983	06/21/1983	76	1863	0.0788		1.34			

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
H6-3-3	Isleton (FRH)	03/04/1983	N/A	N/A	45,775	44	-	-	0	-	-			0	0	9
H6-4-2	Isleton (FRH)	03/28/1983	N/A	N/A	47,518	49	04/08/1983	06/29/1983	3	3645	0.0487	0.17		0	0	36
	Total				93,293		04/08/1983	06/29/1983	3	3645	0.0487		0.08			
H6-3-4	Courtland (FRH)	03/08/1983	N/A	N/A	48,841	47	05/10/1983	05/10/1983	1	288	0.1388	0.62		0	0	14
H6-4-3	Courtland (FRH)	03/31/1983	N/A	N/A	48,801	51	04/12/1983	05/24/1983	6	3645	0.0482	0.33		0	0	82
	Total				97,842		04/12/1983	05/24/1983	7	3645	0.0482		0.19			

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
H6-3-5	Lower Mokelumne (FRH)	03/14/1983	N/A	N/A	45,980	N/A	04/26/1983	04/26/1983	1	200	0.1388	0.02		0	0	11
H6-4-1	Lower Mokelumne (FRH)	03/24/1983	N/A	N/A	47,347	48	04/15/1983	04/18/1983	2	380	0.0528	0.10		0	0	41
	Total				93,327		04/15/1983	04/26/1983	3	780	0.0451		0.09			
H6-3-6	Lower Old River (FRH)	03/17/1983	N/A	N/A	47,677	49	-	-	0	-	-			0	0	61
H6-3-7	Lower Old River (FRH)	03/22/1983	N/A	N/A	49,980	48	05/18/1983	05/18/1983	1	200	0.1388	0.02		0	0	80
	Total															
6-62-24	Courtland (FRH)	05/16/1983	52	60	96,706	79	05/18/1983	06/10/1983	82	3370	0.1018	1.22		0	0	428
6-62-26	Lower Old River (FRH)	05/17/1983	53	63	89,500	78	05/22/1983	06/10/1983	23	2770	0.0882	0.35		0	0	90
6-62-25	Lower Mokelumne (FRH)	05/19/1983	56	63	83,436	75	05/24/1983	06/15/1983	72	3183	0.0881	1.17		0	0	270
6-62-23	Isleton (FRH)	05/20/1983	57	61	92,003	81	05/22/1983	06/07/1983	95	2390	0.0990	1.39		0	0	388
6-62-30	Port Chicago (FRH)	05/23/1983	60	67	43,374	75	-	-	0	-	-					120
1982																
Fall Run Releases																
Upper Sacramento River and Tributaries																
H6-2-2	Below RBDD (CNFH)	03/08/1982	N/A	N/A	41,753	44	04/13/1982	04/23/1982	4	340	0.0215	0.88		0	0	114
H6-2-6	Below RBDD (CNFH)	03/25/1982	N/A	N/A	43,673	44	05/03/1982	05/21/1982	5	2980	0.0780	0.20		0	0	116
	Total				85,426				9	2620	1.0184		0.01			
6-60-26	Battle Creek (CNFH)		N/A	N/A	42,964	80	05/13/1982	06/07/1982	37	2540	0.0878	1.65		0	0	295
6-60-27	Battle Creek (CNFH)		N/A	N/A	41,738	80	05/13/1982	05/24/1982	27	1920	0.1111	0.76		0	0	487
	Total	05/05/1982			84,702		05/13/1982	06/07/1982	64	2540	0.0878		1.45			
6-60-28	Below RBDD (CNFH)		N/A	N/A	44,308	82	05/13/1982	06/15/1982	34	3940	0.0855	1.24		0	0	339
6-60-29	Below RBDD (CNFH)		N/A	N/A	43,817	82	05/10/1982	05/24/1982	35	2120	0.0881	1.08		0	0	380
	Total	05/05/1982			88,125		05/10/1982	06/15/1982	69	4340	0.0815		1.25			
6-60-30	Knights Landing (CNFH)		N/A	N/A	44,735	81	05/10/1982	05/24/1982	50	2120	0.0881	1.48		0	0	398
6-60-31	Knights Landing (CNFH)		N/A	N/A	44,540	81	05/10/1982	05/24/1982	41	2120	0.0881	1.22		0	0	304
	Total	05/05/1982			89,275		05/10/1982	05/24/1982	91	2120	0.0881		1.35			
Sacramento-San Joaquin Estuary																
H6-2-3	Isleton (CNFH)	03/11/1982	N/A	N/A	43,248	44	-	-	0	-	-			0	0	32
H6-2-7	Isleton (CNFH)	03/03/1982	N/A	N/A	40,508	45	05/17/1982	05/17/1982	1	200	0.1388	0.02		0	0	11
	Total				83,756											
H6-2-4	Mokelumne R. (CNFH)	03/17/1982	N/A	N/A	43,840	43	-	-	0	-	-			0	0	24
H6-3-2	Mokelumne R. (CNFH)	03/10/1982	N/A	N/A	41,470	44	-	-	0	-	-			0	0	22
	Total				85,310											
H6-2-5	Berkeley (CNFH)	03/22/1982	N/A	N/A	40,889	44	-	-	0	-	-			0	0	5
H6-3-1	Berkeley (CNFH)	03/08/1982	N/A	N/A	39,321	44	-	-	0	-	-			0	0	0

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (mm)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
	Total				80,020											
6-46-28	Dos Rios (MRFF)	04/24/1982	N/A	N/A	48,227	67	05/10/1982	05/20/1982	23	1720	0.1086	0.57		0	0	552
6-62-20	Discovery Park (FRH)	05/11/1982	N/A	60	85,885	78	05/14/1982	06/17/1982	100	4080	0.0810	1.87		0	0	1282
6-62-18	Discovery Park (CNFH)	05/12/1982	N/A	68	89,760	78	05/18/1982	06/09/1982	136	2580	0.0889	2.86		0	0	1065
6-62-19	Port Chicago (CNFH)	05/17/1982	N/A	N/A	86,877	78	-	-	0	-	-					782
6-62-21	Discovery Park (FRH)	06/04/1982	58	66	90,022	76	06/09/1982	06/17/1982	30	1820	0.1173	0.86		0	0	382
6-62-22	Port Chicago (FRH)	06/08/1982	N/A	N/A	63,221	72	06/09/1982	06/17/1982	41	-	-					385
Upper San Joaquin River and Tributaries																
6-46-17	Merced River Fish Facility	04/22/1982	N/A	N/A	49,217	68	05/13/1982	05/18/1982	18	4080	0.0808	0.62		24	8	428
1981																
Fall Run Releases																
Upper Sacramento River and Tributaries																
H6-1-1	Below RBDD (CNFH)	02/06/1981	N/A	N/A	35,905	41	-	-	0	-	-			0	0	42
H6-1-5	Below RBDD (CNFH)	02/20/1981	N/A	N/A	47,019	40	03/11/1981	03/11/1981	2	200	0.1389	0.04		0	0	65
	Total				82,924		03/11/1981	03/11/1981	2	200	0.1389		0.02			
6-5-66	Coyote Creek (TCFF)	05/08/1981	N/A	N/A	11,031	88	05/14/1981	05/14/1981	1	200	0.1389	0.08		0	0	155
6-5-67	Coyote Creek (TCFF)	05/13/1981	N/A	N/A	10,823	80	05/21/1981	05/21/1981	3	200	0.1389	0.26		0	0	177
6-60-16	Battle Creek (CNFH)	05/18/1981	N/A	N/A	86,213	78	05/20/1981	05/20/1981	5	300	0.0833	0.09		0	0	291
6-60-17	Below RBDD (CNFH)	05/18/1981	N/A	N/A	84,987	79	05/20/1981	05/20/1981	8	300	0.0833	0.15		0	0	304
6-60-20	Knights Landing (CNFH)		N/A	N/A	43,069	77	05/20/1981	05/20/1981	3	100	0.1111	0.08		0	0	175
6-60-21	Knights Landing (CNFH)		N/A	N/A	43,552	77	05/20/1981	06/04/1981	2	400	0.0417	0.14		0	0	246
	Total	05/18/1981			86,621		05/20/1981	06/04/1981	5	400	0.0417		0.18			
6-62-13	Feather River Hatchery				87,438	80	-	-	0	-	-			0	0	8
6-62-16	Feather River Hatchery				91,393	80	-	-	0	-	-			0	0	12
	Total	06/01/1981	56	56	178,831											
Sacramento-San Joaquin Estuary																
H6-1-4	Berkeley (CNFH)	02/25/1981	N/A	N/A	49,705	44	-	-	0	-	-			0	0	6
H6-2-1	Berkeley (CNFH)	03/09/1981	N/A	N/A	38,901	43	-	-	0	-	-			0	0	0
	Total				88,606											
H6-1-3	Mokelumne R. (CNFH)	02/20/1981	N/A	N/A	48,103	44	-	-	0	-	-			2*	0	10
H6-1-7	Mokelumne R. (CNFH)	03/09/1981	N/A	N/A	45,786	43	-	-	0	-	-			2*	0	38

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Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
	Total				90,989											
H6-1-2	Isleton (CNFH)	02/12/1981	N/A	N/A	40,916	45	-	-	0	-	-			3*	0	16
H6-1-6	Isleton (CNFH)	03/04/1981	N/A	N/A	45,946	43	-	-	0	-	-			0	0	72
	Total				86,865											
6-58-23	Rio Vista (FRH)	06/02/1981	N/A	72	8,884	83	06/04/1981	06/08/1981	9	800	0.1194	1.11		0	0	219
6-62-14	Discovery Park (FRH)				71,932	91	06/10/1981	06/10/1981	1	100	0.1111	0.02		0	0	24
6-62-17	Discovery Park (FRH)				68,316	89	-	-	0	-	-	0.00		0	0	22
	Total	06/04/1981	57	76	140,248	90	06/10/1981	06/10/1981	1	100	0.1111		0.01			
6-62-15	Port Chicago (FRH)	06/08/1981	5[illegible]	76	76,339	90	06/08/1981	06/08/1981	2	100	0.1111	0.03		0	0	2198

1980

Fall Run Releases

Upper Sacramento River and Tributaries

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
H5-3-1	Below RBDD (CNFH)	02/29/1980	N/A	N/A	25,618	47	-	-	0	-	-			0	0	134
H5-3-2	Below RBDD (CNFH)	02/29/1980	N/A	N/A	22,880	47	-	-	0	-	-			0	0	121
H5-3-5	Below RBDD (CNFH)	03/31/1980	N/A	N/A	21,788	45	05/15/1980	05/16/1980	1	200	0.1389	0.04		0	0	189
H5-3-6	Below RBDD (CNFH)	03/31/1980	N/A	N/A	21,836	45	-	-	0	-	-			0	0	130
	Total				91,800		05/15/1980	05/16/1980	1	200	0.1389		0.01			
6-62-7	Feather River Hatchery	06/03/1980	56	55	88,335	94	06/10/1980	06/23/1980	15	2733	0.1366	0.16		0	0	292
6-62-10	Feather River Hatchery	06/05/1980	56	56	88,516	93	06/12/1980	06/22/1980	15	2170	0.1374	0.16		0	0	497

Sacramento-San Joaquin Estuary

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	SWP	EXPANDED OCEAN RECOVERIES
H5-2-4	Berkeley (CNFH)		N/A	N/A	21,939	46	-	-	0	-	-			0	0	3
H5-2-5	Berkeley (CNFH)		N/A	N/A	20,788	46	-	-	0	-	-			0	0	0
	Total	02/28/1980			42,727											
H5-2-6	Clarksburg (CNFH)	02/29/1980	N/A	N/A	22,121	50	-	-	0	-	-			0	0	29
H5-2-7	Clarksburg (CNFH)	02/28/1980	N/A	N/A	21,624	50	-	-	0	-	-			0	0	50
H5-3-3	Clarksburg (CNFH)	03/31/1980	N/A	N/A	23,909	46	04/17/1980	06/01/1980	2	700	0.0362	0.31		0	0	28
H5-3-4	Clarksburg (CNFH)	03/31/1980	N/A	N/A	22,829	44	04/24/1980	06/01/1980	2	520	0.0461	0.26		0	0	42
	Total				90,482		04/17/1980	06/01/1980	4	700	0.0362		0.16			
6-62-8	Discovery Park (FRH)	06/03/1980	52	62	88,586	96	06/08/1980	06/27/1980	33	4315	0.1382	0.32		0	0	951
6-62-11	Discovery Park (FRH)	06/06/1980	52	62	84,843	96	06/08/1980	06/23/1980	34	3136	0.1381	0.30		0	0	678
6-62-9	Port Chicago (FRH)	06/10/1980	56	65	88,700	92	06/16/1980	06/16/1980	2	-	-					1882
6-62-12	Port Chicago (FRH)	06/13/1980	55	63	79,443	92	06/12/1980	06/18/1980	4	-	-					1788

Appendix 2: Continued

TAG CODE	RELEASE SITE/STOCK	DATE	TRUCK TEMP	RELEASE TEMP	NUMBER RELEASED	AVERAGE SIZE (MM)	FIRST DAY RECOVERED	LAST DAY RECOVERED	NUMBER RECOVERED	MINUTES FISHED	PERCENT SAMPLED	SURVIVAL INDEX	GROUP SURVIVAL	EXPANDED SALVAGE NUMBERS CVP	EXPANDED SALVAGE NUMBERS SWP	EXPANDED OCEAN RECOVERIES
1979																
Fall Run Releases																
Upper Sacramento River and Tributaries																
6-62-4	Feather River Hatchery	06/04/1979	N/A	N/A	101,020	79	-	-	0	-	-			0	0	9
Sacramento-San Joaquin Estuary																
6-62-5	Discovery Park (FRH)	06/08/1979	64	68	100,151	75	06/10/1979	06/25/1979	50	2133	0.0052	0.43		0	0	99
6-62-6	Port Chicago (FRH)	06/08/1979	67	69.5	110,122	87	06/15/1979	06/15/1979	1	-	-					837
1978																
Fall Run releases																
Upper Sacramento River and Tributaries																
6-62-1	Feather River Hatchery	06/06/1978	N/A	N/A	170,000	80	-	-	0	-	-			0	0	0
Sacramento-San Joaquin Estuary																
6-62-2	Discovery Park (FRH)	06/08/1978	57	73	162,253	91	-	-	0	-	-			0	0	54
6-62-3	Port Chicago (FRH)	06/08/1978	57	68	104,700	80	06/08/1978	06/08/1978	1	200	0.1300	0.01		0	0	5300

Notes:

(1) 8 fish subtracted to correct for 10,500 inadvertently released with the Georgiana Slough group on 4/14/92. 0.076% of the 6-1-14-3-2 code group released at Georgiana Slough was recovered at Chipps Island. Thus, we assume survival of the 10,500 6-1-14-3-1 fish released at Georgiana Slough to be 0.076% (8 fish).
(2) These groups were at large during the period of non-sampling, May 24, 26, 27 and 28, thus estimates of survival are biased low by an unknown amount.
(3) The original data has been changed to reflect only tagged fish caught before the non-sampling period.
(4) 6 fish subtracted from Miller Park recoveries due to 6,316 fish inadvertently being released with the Port Chicago group (tag # 6-31-9).
(5) 6,316 fish subtracted from total number released due to 12.2% having tag # 6-31-10 (Miller Park).
(6) 1 fish was recovered at Chipps Island on June 26th, but was not included so that the survival indices would not be biased.
(7) Total number recovered for both tag # 6-62-61 and 6-62-62 is reduced by 1 since one fish for each code.
was recorded as being recovered at Chipps Island on the day of release (6/23).

* = Unexpanded recovery

In some cases average size was calculated from # fish / lb. using a conversion table (Table I-6, Fish Hatchery Management, USFWS, 1982)

FRH = Feather River Hatchery
CNFH = Coleman National Fish Hatchery
MRFF = Merced River Hatchery
MOK= Mokelumne River Hatchery
TRFF = Tuolumne River Fish Facility
TCFF = Tehama-Colusa Fish Facility

END

1-18-02